EXECUTIVE SUMMARY

This paper presents a method for predicting cyclical downturns and upturns in India's exports using the 36 country real effective exchange rate and leading indices of major trading partners. These leading indices are developed at the Economic Cycle Research Institute, New York and forecast the onset and end of recessions in overall economic activity in these economies. The results show that the new leading index of Indian exports (in level and growth form) would have anticipated most of the cyclical turns in real exports, the price of exports, and their value over the past 25 years.

The rationale for the construction of the leading index for exports is that peaks and troughs in the business cycle and/ or growth rate cycle in the domestic economy are likely to be associated with exports to and imports from respective trading partners. For any economy, these cyclical upswings and downswings can be predicted by leading indices, typically six to nine months in advance, or, better still, by long leading indices that typically have a few months' extra lead over traditional leading indices. These cyclical changes in domestic demand also encompass the demand for imports. This implies that a leading index of a trading partner can provide useful information on exports of any exporting country. This notion can be extended to a group of countries importing goods from a country and a weighted average of the leading indices of these countries can be used to predict fluctuations in that country's exports.

In addition to the cyclical fluctuations in a given country's trading partners, movements in the exchange rate are also a vital harbinger of future exports. It is of course expected that a cyclical expansion in the economies of the trading partners would herald an increase in exports of a given country. If,

however, this is accompanied by a depreciation in the currencies of the trading partners, the net impact on the given country's exports will be ambiguous since the expansionary impact will be partly or wholly offset by the increasing cost of imports faced by the trading partners. Therefore, exchange rate fluctuations must also be taken into account along with cyclical factors in a given country's trading partners to accurately gauge current and future exports of the country.

The leading index for the level of future Indian exports comprises the Real Effective Exchange Rate (REER) and a 15-country long leading index. The REER index (RBI, 1993) used is based on export weights and official exchange rates from January 1975 to February 1992 with base 1985=100. From March 1992, FEDAI indicative rates are used and the base moves to 1993-94=100. The number of countries used is 36 that represent 65-70 percent of total exports/trade during 1975 and 1991. The 15 country index is a weighted average of the ECRI long leading indices for 15 economies that trade with India. The 15 countries are the U.S., Canada, Mexico, Germany, France, the U.K., Italy, Spain, Switzerland, Sweden, Japan, Korea, Taiwan, Australia and New Zealand, which collectively account for about half of India's total exports.

Three target variables are used:

- Real exports measured by the quantum index of exports;
- Price of exports measured by the unit value index of exports; and
- Total value of exports which is the product of the above two variables.

The leading exports index is used to predict each of these variables. The economic rationale is very simple. The leading exports index has two basic components – the exchange rate

which determines price competitiveness and the 15 country long leading index covering the export markets which determines the cyclical movement of demand in the consuming countries. It follows that both these variables predict the movements in the future level/growth rate of exports.

Traditionally, the leading exports index has been used to forecast exports. In the case of India, we extend the analysis to encompass the price of exports as an additional target variable. The logic is as follows. When the rupee weakens, the unit value of future exports in rupees tends to rise, and vice versa. Further, when demand in the consuming countries rises, so does the price, raising the unit value of the exports. Another motivation for using the unit value series as a target variable is the numerical quotas (rather than value) that many Indian exports like textiles have traditionally faced. The implication is that exporters would try to export higher unit value items. The analysis is further generalized by using the total value of exports as an alternative target variable. If the economic rationale holds for real exports and the price of exports, it must also be valid for the product of the two.

Since cyclical declines in the level of exports are relatively rare whereas cyclical movements in the growth rate of exports are more prevalent, our analysis uses both the level and its growth rate to predict the three target variables in level as well as in growth form. The estimations begin in 1975 since REER is not available before this period. The leading index for exports is constructed with base 1992=100. Since the components of the leading index are available monthly, the leading index is estimated on a monthly basis. The target variables are, however, currently available only on a quarterly basis and are converted to monthly series by simple step interpolation, that is, the quarterly series is repeated three times corresponding to the months of the quarter. Although monthly data on the

export variables is available up to 1985, this is converted to quarterly to conform to data after 1985 as well as to smoothen the series. The data for the entire period are seasonally adjusted using the Census X-11 procedure.

The reference chronology (peaks and troughs) of the three target variables in level as well as in growth form are determined using the NBER procedure.

The main findings are as follows:

Target Variables: Level and growth rate of quantum index of exports:

- The level of the leading index for exports leads the level of the quantum index 60% of the time at peaks, by an average of 2 months. However, it leads only half the time at troughs.
- The growth rate of the leading index leads the quantum index growth rate at 100% of peaks and 80% of troughs, with the average lead being 9 months at peaks and 1 month at troughs.

Target Variables: Level and growth rate of unit value index of exports

- The level of the leading index leads the level of the unit value index 100% of the time at peaks and also at the one trough, the average lead being 8 months at peaks and 11 months at the only trough.
- The growth rate of the leading index leads the unit value index growth rate at 100% of both peaks and troughs, with the average lead being 16 months at peaks and 15 months at troughs.

Target Variables: Level and growth rate of total value of exports

- The level of the leading index leads the level of the total value index 100% of the time at peaks and 50% of the time at troughs, the average lead being 8 months at peaks and 3 months at troughs.

- The growth rate of the leading index leads the growth rate of the total value index at 100% of peaks and 80% of troughs, with the average lead being 9 months at both peaks and troughs.

The significance of the cyclical leads is further tested on the basis of non-parametric statistical tests which yield the lead profile. The lead profile is a graphical depiction of the leads in strictly probabilistic terms that aids meaningful comparisons between two indices or an index and the reference cycle.

On the basis of the lead profiles, we can conclude that in general, the performance of the growth rates is better compared to the level variables. Further, in order of performance of the variables, the growth rate of the unit value index ranks first followed by the growth rate of the total value of exports.

In sum, the findings of the study indicate that the level of the leading index for exports leads the quantum index, the unit value index, and the total value index. Furthermore, the growth rate of the leading index leads the growth rates of each of the above three target variables. These findings are very encouraging considering how volatile the series are. The results are also robust in the sense that the standard deviations of the leads are typically low, under 10 months for the overall lead. It is also noteworthy that despite data limitations and

other problems experienced by a developing country dominated by the public sector and import substituting industrialisation in the past, the leading index performed reasonably well. In light of its past performance, we can confidently infer that its performance can only be expected to improve further in the future.

“A LEADING INDEX FOR INDIA’S EXPORTS”

Pami Dua
Anirvan Banerji

INTRODUCTION

With the recent increase in globalization of the Indian economy, policy makers, businesses, and financial analysts are closely tracking the external sector. A key driver in the external sector is the level of exports because it directly impacts the domestic economic performance. Since exports can affect fluctuations in the growth rate and the level of overall economic activity, it is essential to construct an accurate and reliable tool for forecasting the direction of change of the level and growth rate of exports. This study reports such a measure – the leading index for exports – that predicts movements in real exports, price of exports, and the value of exports respectively.

The leading indicator approach to business and economic forecasting is based on the premise that market-oriented economies experience business cycles that consist of “expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals that merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic” (Burns and Mitchell, 1946). The leading indicator approach therefore predicts these repetitive sequences of the business cycle.

This study focuses on the external sector of the Indian economy. Since the external sector is expected to be driven

largely by other countries' economic cycles, it will typically not be in synchronization with domestic business cycles. For this reason, a leading index for the aggregate domestic economy may not be a satisfactory predictor of the external sector. Hence, a separate, specialized leading index is required to forecast cycles in the external sector. This study constructs such an index to predict movements in exports.

Part I presents an overview of the external sector in the Indian economy. Part II describes the underlying rationale for constructing a leading index for exports. It also outlines the methodology for construction. Part III comments on the performance of the leading index for the three target variables – real exports, price of exports, and the value of exports over the past 25 years. It also evaluates the leading index with respect to lead profiles. The section that follows concludes the study and notes the limitations of the present study.

PART I

A REVIEW OF FOREIGN TRADE AND OTHER RELATED DEVELOPMENTS

The past 50 years have witnessed several changes in the external sector. With liberalization and the increase in openness of the Indian economy, the external sector now has a key role to play in India's development process.

In 1950, India's share in world exports was 1.9 percent. This compared favourably with 0.9 percent in China and 1.4 percent in Japan (Srinivasan and Tendulkar, 1999). By 1965, however, the share had dropped to 1 percent (Bhagwati and Desai, 1970) and it continued to fall progressively to one-fifth its initial level to 0.45 percent in 1980 and recovered marginally in 1997 to 0.62 percent (Table 1).This was in sharp contrast to Japan's and China's experience. The Chinese share in world exports, after initially falling to a low of 0.7 percent in 1977 increased to 3.2 percent in 1997 while Japan's share increased from 1.4 percent in 1950 to a peak of 10.3 percent in 1986 (Srinivasan and Tendulkar, 1999). This rapid growth was achieved by Japan's emphasis on export orientation to industrialisation and China's change in policy towards progressive integration with the world economy since 1978. India, on the other hand, persisted with the inward orientation in its policies till 1991 with a gradual change towards globalization after that. While there was some change in emphasis on exports reflected in the ratio of exports to GDP (Table 2) that rose from an annual average of 3.41 percent in the 1960s to 3.68 percent in the first half of the 1970s and to 5.26 percent in the latter part of the 1970s, import substitution primarily dominated the development strategy until the end of the 70s. More recently, the exports to GDP ratio has grown to almost 8.5 percent.

We begin with a broad overview of India's external sector since the 1950s[1]. Until the crisis of 1991, India's trade policy was based on three main objectives (Marjit and Chaudhuri, 1997): preservation of employment in the import competing sectors; raising revenue through trade restrictions; and promoting self-reliant industrialisation. Bhagwati and Srinivasan's (1993) study clearly shows that exports were not given adequate attention until the early 90s, when the foreign exchange reserves were at an all-time low. Exports were, in fact, discouraged due to the pro-import competing policies.

During the first half of the 1950s, the assumption of export pessimism led to high export taxes and investment in the export sector was neglected. Further, the import regime was quite liberal. In fact, capital controls were more restrictive than import controls. (Joshi and Little, 1994).

It was with the Second-Five Year Plan covering the period 1956-61 that a strategy for development was adopted. This strategy emphasised the establishment of basic and heavy industries for rapidly industrialising the economy. However, the implementation of the strategy led to a massive increase in imports in the first two years of the Second Plan. Imports increased by about 23 percent in 1957-58 (Table 5). This was on account of the rational expectation of the private sector of an increase in import demand, which was implied by the development strategy and the anticipated shortage of foreign exchange (Srinivasan and Tendulkar, 1999). This phenomenon was accompanied by a severe balance of payments crisis in 1957. This led to introduction of import controls for managing the balance of payments crisis.

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[1] Comprehensive reviews of India's foreign trade and external sector since independence are given in Hajra and Sinate (1997) and Kapur (1997). Srinivasan (1999) provides a phase chronology of the Indian foreign trade regimes from 1950 to 1991.

Hence, during the latter part of the 1950s, import substitution was considered a major part of India's trade and industrial policies. The strategy of import substitution was adopted in view of the adverse trading environment, the limited possibility of expanding import purchasing power through exports and the objective of self-reliance. Thus, comprehensive import licensing was introduced that had 'indigenous clearance' as an important feature. Under this, automatic quota protection was provided to any imports for which domestic substitutes were available.

Foreign trade was not considered a stimulant to India's economic growth and policy makers underestimated the export possibilities. This is evident from a decline of the ratio of exports to GDP from 5.74 percent in the first half of the 1950s to 4.49 percent in the latter half of the 1950s (Table 2). Furthermore, in the latter part of 1950s, inflation in India was higher than inflation abroad and exports stagnated as a result of the appreciation of the real exchange rate (Joshi & Little, 1994). This also accounted for a decline in the ratio of exports to GDP as mentioned above. During the 1950s, the annual average growth rate for exports was 1.15 percent as compared to 6.9 percent for imports, a direct fallout of the development policy adopted during this period (Table 5).

In contrast to the 1950s, export promotion received attention in the 1960s. This was largely to offset the undesired consequences of quantitative restrictions on exports. In terms of the types of export promotion measures adopted, the 60s can be divided into three phases. In the first phase from 1962 through the middle of 1966, government introduced various subsidies for exports. The export subsidy extended during this period can be classified into the three categories of fiscal measures, import entitlement schemes and other promotional measures related to information dissemination on export opportunities and marketing development. Consequently, during the first half of the 60s, exports increased by 5.11 percent in nominal terms and 4.48

percent in real terms as compared to 1.7 percent and 2.22 percent respectively for the second half of the 50s. (Table 5).

In the second phase, during June 1966, the subsidies were replaced with the devaluation of the exchange rate. As a result, the nominal effective exchange rate declined by 24 percent and the real effective exchange rate by 18 percent, the lower real rate reflecting high levels of domestic inflation (Table 6). Devaluation was also accompanied by abolition of all the pre-devaluation export promotion schemes and reduction in tariffs. Further, export duties were imposed. In terms of performance, exports increased by 42 percent during 1966-67 in nominal terms when measured in domestic currency. However, in real terms exports declined by 4 percent (Table 5). This shows that the increase in export earnings in terms of domestic currency was solely because of the price effect of devaluation. This is also reflected in the change in the unit value index, which increased by 49 percent during 1966-67 (Table 4).

However, the expected effects of trade policy rationalization were not realized, as they were offset by the price increases induced by two successive droughts, their adverse impact on traditional exports and the onset of an industrial recession. Further, the removal of export subsidies and introduction of export taxes reduced the extent of net devaluation. This is reflected in the decline in export earnings (measured in US$ terms) by 2.1 percent during 1966-67 to 1967-68.

Soon after, modified schemes of the previously existing subsidies were reintroduced. Despite the devaluation and the subsequent reintroduction of export incentives, aggregate export earnings did not change substantially. During the latter half of the 60s exports increased by 2 percent in US$ terms, which was less than 5 percent for the first half of 60s.

In August 1971 the US dollar was no longer tied to gold. This brought an end to the era of fixed exchange rate regime. In the case of India, a pegged exchange rate regime was followed. The peg was initially to the US dollar (from August 1971 to December 1971) and later on to the floating Pound Sterling (till September 1975), which happened to be depreciating against the US dollar (Joshi & Little, 1994). The nominal effective exchange rate depreciated at an annual average rate of 4.74 percent during the first half of the 70s, whereas the real effective exchange rate depreciated by 2.74 percent during the same period (Table 6). Thus despite high inflation on account of severe droughts in 1972 and 1974, the sterling peg led not only to a nominal effective depreciation, but also to a real effective depreciation. Import controls were tightened in response to the oil price shock of 1973. However, increase in export incentives and depreciation in the real effective exchange rate helped boost India's exports during the first half of the 70s. As shown in Table 5, exports increased by 19 percent in nominal terms and 5.8 percent in real terms.

Effective September 1975, the Rupee was pegged to a basket of currencies of India's major trading partners. This change was on account of the downward pressure on the Pound Sterling vis-à-vis major international currencies following the breakdown of the Bretton Woods system. This resulted in the misalignment of the Rupee vis-à-vis other currencies. Another factor was a decline in the importance of UK in India's trade. The exchange rate was fixed by the Reserve Bank of India within a band of ± 2.25 percent with reference to a basket value base that was increased to ± 5 percent in January 1979. In 1976, the average annual fall in REER was 12.2 percent. This trend was reversed in 1980 when REER rose annually by almost 10.95 percent (Table 6). After that, external trade competitiveness improved in the 1980s as indicated by the decline in the REER.

Export performance improved in the 1970s and the ratio of exports to GDP (Table 2) increased from 3.35 percent in 1970-71 to 5.29 percent in 1979-80. Real exports grew especially in the second half of the 70s touching a high of 18.5 percent annualized growth rate in 1976-77 (Table 5). Importantly, while the exchange rate in nominal effective terms appreciated by 0.74 terms during the latter half of the 70s, in real effective terms it depreciated by 1.14 percent (Table 6). This increased the price competitiveness of Indian goods in the world market. There were two changes in the policies adopted in the 1970s. First, the coverage of export promotion measures was increased. Second, in the late 1970s, there was some import liberalisation that enabled shifts of some items from the restricted list to the open general license list. The buoyancy in world trade also helped to increase India's foreign trade although India's share in world exports dropped from 0.68 percent in 1970 to 0.45 percent in 1980 (Table 1).

During the early eighties, oil prices increased sharply and the overall conditions were not conducive to international trade and foreign aid. Since the mid eighties, however, a more active exchange rate policy was implemented. Further, the 1980s experienced severe pressures on balance of payments. Due to the two oil shocks in the 1970s, the terms of trade deteriorated significantly (Table 4) and the growth in real exports (quantum index) was less than 2% in the beginning of the 1980s whereas real import growth was close to 20% (Table 5). The pressure on balance of payments soon eased mainly as a result of moderation in imports. The growth in exports remained low until the mid 80s due to the slow recovery of world demand. The ratio of exports to GDP declined from 5.2 percent in the second half of the 70s to 4.6 percent in the first half of the 80s (Table 2). The 80s also witnessed a change in the policy stance towards the exports sector. In the 70s some measures of export promotion were undertaken but generally

export pessimism prevailed. In the 80s, a cautious optimism of the export potential set in, perhaps due to the robust performance of exports in the 70s. Consistent with the 'growth-led exports' notion, the policy response was positive. Changes in the rules for import licensing facilitated imports of capital goods and other quality imports for export production at competitive prices. Further, the exchange rate was adjusted frequently to maintain international competitiveness.

Systematic liberalisation measures were introduced in the second half of 80s. These covered gradual relaxation of the rigours of quantitative restrictions (e.g. increased foreign exchange allocation for imports, procedural simplifications etc. while maintaining a quantitative restrictions based administrative system). Furthermore, attempts were made to reduce administrative delays associated with imports and exports. In terms of performance, exports and imports increased in real terms by almost 8 percent each respectively. In nominal terms, exports and imports increased by 11.6 percent and 8.2 percent per annum in US$ terms (Table 5). This was on account of a cumulative depreciation in the real effective exchange rate to the extent of 32 percent during 1984 to 1991 compared to almost 10 percent appreciation in the previous five years (Table 6). Furthermore, there was a significant pick up in the volume of world exports following the adjustment of the world economy to the two oil shocks.

However, in the second half of the 1980s, pressure on balance of payments increased culminating in the unprecedented payments crisis at the start of the 90s. Imports in real terms grew between 1985-90, especially in the first two years (Table 5) before a temporary dip in 1987-88. At the same time external indebtedness increased sharply and the debt service ratio accelerated between 1989-92 (Table 3).

In the year 1990-91, the Indian economy suffered an unprecedented external payments crisis. By then, the debt-service ratio had increased to over 35 percent. Further, the Gulf crisis of August 1990 resulted in a big increase in the oil import payments. There was also a large fall in workers' remittances from the Gulf region. With the increase in domestic uncertainty and the downgrading of sovereign credit ratings, international creditors did not roll over loans. At the same time, net inflows into non resident deposits diminished and there was a huge depletion of reserves. These problems prompted the package of structural reforms that was adopted in July 1991.

The reforms of 1991 resulted in a downward adjustment in the exchange rate as reflected in over 19 percent decline in NEER in 1991. Major reforms in trade and industrial policies were adopted that abolished licensing and favoured an increase in exports. Finally, exports growth picked up between 1993-96 substantially before slowing down in 1996-97 (Table 5). The share of exports to GDP rose from 5.73 percent in 1990-91 to 9 percent in 1995-96 (Table 2). Some of the factors explaining the slowdown in India's foreign trade in 1996-97 are the slowdown in world trade, sharp fall in international prices for manufactured goods and low economic growth in the industrialised countries (Hajra and Sinate, 1997).

With the enormous fluctuations experienced in the exports sector in the past, a key question is whether it is possible to provide an early warning signal for at least some of these changes. This study aims to create such a signal for the movements in the exports sector.

PART II

RATIONALE AND METHODOLOGY

The construction of the leading index for exports is based on the premise that peaks and troughs in the business cycle and/or growth rate cycle[2] in the domestic economy are likely to be associated with exports to and imports from respective trading partners. For any economy, these cyclical upswings and downswings can be predicted by leading indices, typically six to nine months in advance. These cyclical changes in domestic demand also encompass the demand for imports. This implies that a leading index of a trading partner can provide useful information on exports of any exporting country. This notion can be extended to a group of countries importing goods from a country and a weighted average of the leading indices of these countries can be used to predict fluctuations in that country's exports (Moore, 1976; Klein and Moore, 1978, 1980).

In addition to the cyclical fluctuations in a given country's trading partners, movements in the exchange rate are also a vital harbinger of future exports. It is of course expected that a cyclical expansion in the economies of the trading partners would herald an increase in exports of a given country. If, however, this is accompanied by a depreciation in the currencies of the trading partners, the net impact on the given country's exports will be ambiguous since the expansionary impact will be partly or wholly offset by the increasing cost of imports faced by the trading partners. In other words, exchange rate fluctuations must also be taken into account along with cyclical

[2] Business cycles are fluctuations in the level of aggregate economic activity while growth rate cycles are upswings and downswings in the growth rate of economic activity (Burns and Mitchell, 1946; Moore, 1982; Klein, 1998). These concepts are analysed in the Indian context in Chitre (1982; 1986) and Dua and Banerji (2000).

factors in a given country's trading partners to accurately gauge current and future exports of the country.

In a study of U.S. exports, Cullity, Klein and Moore (1987) combine exchange rates with conventional leading indices to predict U.S. exports. They note that exchange rates have almost half a year's extra lead over exports compared to that of leading indices.

In a more recent study, the Economic Cycle Research Institute (ECRI, 1997; Hiris et al., 1995) has constructed a leading index of U.S. exports that includes a broadly-based trade-weighted effective exchange rate index, as well as ECRI's long-leading indices of ten industrial economies that include most of the major U.S. trading partners. Long-leading indices[3] improve on the traditional leading indices by increasing the lead time to over a year, on average. That is, long-leading indices have about half a year's extra lead over traditional leading indices. This implies that exchange rates as well as long-leading indices have approximately the same lead over exports and can be combined into a composite exports leading index.

The long-leading indices of these ten countries – Canada, Japan, the United Kingdom, Germany, France, Korea, Taiwan, Italy, Australia, and New Zealand – are combined into a single index by weighting the long-leading indices for each country by their respective average share of U.S. exports over the 1989-95 period. This composite long-leading index is further combined with the 131-country trade-weighted real exchange rate index

[3] Research on long-leading indices was pioneered by Cullity and Moore (1987). These indices have a longer lead compared to the conventional indices. To be considered a long-leading indicator, a series must have an average lead of at least 12 months at business cycle peak dates and 6 months at business cycle trough dates.

compiled by the Federal Reserve Bank of Dallas to yield the leading index for exports.

Cyclical activity in ECRI's leading index for U.S. exports is measured in growth form. This is because cyclical declines in the level of exports are rare whereas movements in their growth rates are relatively more frequent. ECRI's leading index for U.S. exports therefore predicts growth rates in exports. Cycles are thus expressed in growth rates where the growth rate is measured by the "six-month smoothed growth rate." This smoothed growth rate is based on the ratio of the latest month's figure to it's average over the preceding twelve months, annualized and centered about six months before the latest month. Unlike the more commonly used 12-month change, it is not very sensitive to idiosyncratic occurrences 12 months earlier. A number of such advantages make the six-month smoothed growth rate a useful concept in cyclical analysis (Banerji, 1999).

The exchange rate index and the composite leading index both have cyclical movements around a trend that determine the cyclical movements of future exports. Note, however, that the multi-country composite leading index is itself a weighted average of several (in this case, 10) composite indices. The real exchange rate index represents a composite exchange rate and has completely different units from the leading index. The two therefore cannot be combined by simply using a weighted average. Instead, the composite index procedure is used that is especially designed to combine the movements of a number of such heterogeneous cyclical time series. Given the difference in units as well as the cyclical volatility of the exchange rate index and the composite leading index, it is important to ensure that the variable that moves in wide swings does not have a larger influence on the movements of the combined index than one which typically moves in narrow swings. This

is achieved by the process of standardization, which involves adjusting the amplitudes of the two components by dividing each by its own historical cyclical volatility. After standardization, the cyclical movement of each component is expressed in units of its own cyclical volatility. The two standardized components are then aggregated, and the trend and the amplitude of the combined series are adjusted to optimize cyclical performance.[4]

To evaluate the predictive ability of the exports leading index (level or growth form), a reference chronology that dates the downturns in the export sector is required. For this, a single or composite time series is used as the "target" variable and its turning points are determined. These turning points apply to contemporaneous economic activity. For a leading index to be useful, its turning points must precede those of the reference series. The first step in this analysis is therefore to determine the turning points of the reference series and the historical turning points of the leading index.

The choice of turning points is made by mechanical procedures supplemented by rules of thumb and experienced judgment. The initial selection of turning points employs a computer program based on the procedures and rules developed at the National Bureau of Economic Research (see Bry and Boschan, 1971). The selection of a turning point must meet the following criteria: (1) at least five months opposite movement must occur to qualify as a turning point: (2) peaks (troughs) must be at least fifteen months apart; (3) if the data are flat at the turning point, then the most recent period is selected as the turning point. These rules of thumb trace their roots to Burns and Mitchell (1946) and continue to be applied by the Economic Cycle Research Institute (ECRI). Finally, turning

[4] Issues and procedures related to construction of composite indices are discussed in Appendix A.

points must pass muster through the experienced judgment of the researcher. Turning points can be rejected because of special one-time events that produce spikes in the data, indicating turning points. Experienced judgment also excludes non cyclical exogenous shocks.

The methodology described above is applied to the Indian economy and two leading indices are constructed – one in level and the other in growth form. The usefulness of these indices are evaluated with reference to the levels and growth rates of three target variables – real exports, price of exports, and the product of the two, the total value of exports.

PART III

LEVEL AND GROWTH RATE LEADING INDICES FOR INDIAN EXPORTS

The leading index for the level of future Indian exports comprises the Real Effective Exchange Rate (REER) and a 15-country long leading index. The REER index (RBI, 1993) used is based on export weights and official exchange rates from January 1975 to February 1992 with base 1985=100. (Annual indices are available from 1960.) From March 1992, FEDAI indicative rates are used and the base moves to 1993-94=100. The REER index is basically the weighted average of the bilateral nominal exchange rates of the home currency in terms of foreign currencies adjusted by domestic to foreign relative local-currency prices. The exchange rate of a currency is expressed as the number of units of Special Drawing Rights (SDRs) that equal one unit of the currency (SDRs per currency). A fall in the exchange rate of the rupee against SDRs therefore represents a depreciation of the rupee relative to the SDR. Similarly, a rise in the exchange rate represents appreciation of the rupee. The NEER and REER indices are based on bilateral export weights and total trade (exports plus imports) weights. The weights used for each country are reported in Table 7. The number of countries used is 36 that represent 65-70 percent of total exports/trade during 1975 and 1991. Given that 36 countries are used, the weights are normalized accordingly for constructing REER and NEER indices for India. A large number of countries is used to smoothen out the year-to-year variations in the share of any country and to ensure that the pattern of trade is representative over a long span of time.

The 15 country index is a weighted average of the ECRI long leading indices for 15 economies that trade with India.

The 15 countries are the U.S., Canada, Mexico, Germany, France, the U.K., Italy, Spain, Switzerland, Sweden, Japan, Korea, Taiwan, Australia and New Zealand, which collectively account for about half of India's total exports. The weights used in the 15 country long leading index are the percentages of India's exports accounted for by each of these countries in 1995, according to the IMF's Direction of Trade Statistics. The percentage shares given in Tables 8A and 8B are similar to the ones computed from IMF-Direction of Trade Statistics. This is because the primary source for getting such data is the same. The choice of the year 1995 was based on the fact that it was a relatively recent year where the direction of trade flows was not unduly distorted by the Asian crisis or similar developments. Further, as shown in Table 8A, the weights for the G-7 countries (consuming a little less than half of Indian total exports) do not change substantively across the years.

Three target variables are used:

- Real exports measured by the quantum index of exports;
- Price of exports measured by the unit value index of exports; and
- Total value of exports which is the product of the above two variables.

The leading exports index is used to predict each of these variables. The economic rationale is very simple. The leading exports index has two basic components – the exchange rate which determines price competitiveness and the 15 country long leading index covering the export markets which determines the cyclical movement of demand in the consuming countries. It follows that both these variables predict the movements in the future level/growth rate of exports.

Traditionally, the leading exports index has been used to forecast exports. In the case of India, we extend the analysis to encompass the price of exports as an additional target variable. The logic is as follows. When the rupee weakens, the unit value of future exports in rupees tends to rise, and vice versa. Further, when demand in the consuming countries rises, so does the price, raising the unit value of the exports. Another motivation for using the unit value series as a target variable is the numerical quotas (rather than value) that many Indian exports like textiles have traditionally faced. The implication is that exporters would try to export higher unit value items.

The analysis is further generalized by using the total value of exports as an alternative target variable. If the economic rationale holds for real exports and the price of exports, it must also be valid for the product of the two.

As noted in the previous section, cyclical declines in the level of exports are relatively rare whereas cyclical movements in the growth rate of exports are more prevalent. Our analysis therefore uses both the level and its growth rate to predict the three target variables in level as well as in growth form. The leading index in growth form is simply the growth rate of the level of the leading index where the growth rate is the “six-month smoothed growth rate” described in the previous section.

The estimations begin in 1975 since REER is not available before this period. The leading index for exports is constructed with base 1992=100. Since the components of the leading index are available monthly, the leading index is estimated on a monthly basis. The target variables are, however, currently available only on a quarterly basis and are converted to monthly series by simple step interpolation, that is, the quarterly series is repeated three times corresponding to the months of the quarter. Although monthly data on the export variables is

available up to 1985, this is converted to quarterly to conform to data after 1985 as well as to smoothen the series. The data for the entire period are seasonally adjusted using the Census X-11 procedure.

The reference chronology of the three target variables in level as well as in growth form are determined using the procedure described in the previous section. The turning points of each target variable are evaluated relative to those of the leading index. The results are shown in Tables 9-14 and Figures 1 (A to C) – 6 (A to C). **Note that for all the figures, prefix A denotes the leading index for exports, B denotes the 15 country leading index, and C is REER. The data for the 15 country leading index are available for a longer time period. The corresponding graphs are therefore shown from the early 1960s. Graphs based on REER (A and C) start in the mid 1970s. The figures generally show that 'A' *i.e.,* the composite leading index for exports gives the best results in terms of leads. The discussion below is mainly with respect to 'A'.**

The main findings are as follows:

III.1 Target Variables: Level and Growth Rate of Quantum Index of Exports : (Tables 9 and 10; Figures 1A-1C and 2A-2C)

- As shown in Table 9 and Figure 1A, downturns in the level of the quantum index of exports occurred in the following periods:
  - February 1976 to November 1978
  - May 1979 to August 1980
  - February 1989 to May 1990

- November 1991 to November 1992
- August 1996 onwards (The end date for this downturn is not assumed to be known since the data for the target series end in 1998, and no clear cyclical trough is evident before the end of the data. Note that in Figure 1, the shaded region depicting the downturn extends to the end of 1998. This is because the chart convention requires that if a cyclical phase (upturn or downturn) has not been identified as having ended, it will be depicted as continuing until the last available data point in the target series. Thus, if the last identified turning point in the target series is a peak, the shaded area will continue until the last data points in the series.)

❑ The level of the leading index for exports leads the level of the quantum index 60% of the time at peaks, by an average of 2 months. However, it leads only half the time at troughs, thus resulting in an average lag of 2 months. A final trough in 1998 or later is not included in these calculations, but if we conservatively assume a trough in the quantum index in June 1998, the leading index would lead by 15 months at that trough, but the lead would be longer still if the actual trough turned out to be later. In either case, the leading index would thus lead 60% of the time at troughs as well, and the average lead would become at least 1 month at troughs.

❑ Table 10 and Figure 2 report the downturns in the growth rate of the quantum index of exports in the following periods:

- May 1979 to May 1980
- August 1987 to May 1988

- February 1989 to May 1990
- November 1991 to May 1992
- August 1996 onwards (As before, the end date for this downturn is not assumed to be known since the data for the target series end in 1998, and no clear cyclical trough is evident before the end of the data.)

❑ The growth rate of the leading index leads the quantum index growth rate at 100% of peaks and 80% of troughs, with the average lead being 9 months at peaks and 1 month at troughs. Note that a trough in 1998 or later is not included in these calculations, but given the 1997 trough in the leading index, it is likely to have a good lead, perhaps a year or longer, at this trough.

III.2 Target Variables: Level and Growth Rate of Unit Value Index of Exports: Tables 11 and 12; Figures 3A-3C and 4A-4C)

❑ The identification of turning points in the level of the unit value index of exports revealed the following downswings (Table 11 and Figure 3A):

- May 1977 to May 1978
- May 1985 to February 1986
- February 1996 to August 1996

❑ The level of the leading index leads the level of the unit value index 100% of the time at peaks and also at the one trough, the average lead being 8 months at peaks and 11 months at the only trough. The lead is not calculated for the August 1996 trough in the target series since the date of the corresponding official trough in the leading index series has not yet been determined,

and is subject to the availability of more data. However, it has a number of extra cycles, i.e., it is oversensitive, as leading indices often are, turning down ahead of declines in the unit value index that are too small to be called cyclical downturns. As shown in Figure 3A, the 1978-81 downturn in the leading index precedes the 1982 dip in the unit value index although the downswing is not significant enough to be identified as a turning point. Likewise, the 1989-90 downturn in the leading index precedes the 1991 dip in the unit value index and the 1991-93 downturn in the leading index precedes the 1993 dip in the unit value index. Further, the 1994-95 downturn in the leading index also precedes the 1995 dip in the unit value index. All these are classified as extra cycles since these are not "cyclical" downswings although the leading index is predicting these downturns. At the same time, however, in one instance (the 1985-86 cyclical downturn in the unit value index), the leading index dips, but the drop is too small to signal a cyclical downturn. We therefore classify this as a "missed" cycle.

- Recessions in the growth rate of the unit value index of exports are as follows: (Table 12 and Figure 4A)
  - February 1980 to August 1982
  - May 1983 to November 1985
  - May 1988 to May 1989
  - August 1990 to May 1991
  - May 1992 to August 1996
  - February 1997 onwards (The end date for this downturn is not assumed to be known since the data for the target series end in 1998, and no clear cyclical trough is evident before the end of the data.)

- The growth rate of the leading index leads the unit value index growth rate at 100% of both peaks and troughs, with the average lead being 16 months at peaks and 15 months at troughs. Given the early 1997 trough in the leading index, the lead at this last trough in the target series (not included in the calculations) is likely to be well over a year.

III.3 Target Variables: Level and Growth Rate of Total Value of Exports: (Tables 13 and 14; Figures 5A-5C and 6A-6C)

- The downturns in the level of total value of exports are given below: (Table 13 and Figure 5A)
  - February 1977 to November 1978
  - May 1979 to August 1980

- The level of the leading index leads the level of the total value index 100% of the time at peaks and 50% of the time at troughs (there is one lag), the average lead being 8 months at peaks and 3 months at troughs.

- Downswings in the growth rate of the total value of exports are as follows: (Table 14 and Figure 6)
  - May 1979 to May 1980
  - February 1987 to May 1988
  - February 1989 to February 1990
  - February 1993 to May 1994
  - February 1996 onwards (The end date for this downturn is not assumed to be known since the data for the target series end in 1998, and no clear cyclical trough is evident before the end of the data.)

- The growth rate of the leading index leads the growth rate of the total value index at 100% of peaks and 80% of troughs, with the average lead being 9 months at both peaks and troughs. Please note that a trough in 1998 or later is not included in these calculations, but given the 1997 trough in the leading index, it is likely to have a good lead, perhaps a year or longer, at this trough.

The downturn periods identified above especially for the growth rates of the quantum index of exports and of the value of exports can broadly be linked with developments on the domestic and international front. The following discussion highlights some of these changes. Although the estimations begin in January 1975, we describe the domestic and global developments since the early 1970s.

In the first half of the 1970s, the international economic environment facing the oil importing developing countries was highly unfavourable after the first oil shock of 1973. For these countries, the problems created by the increased import costs of oil were compounded by the combination of inflation and recession in developed countries. The recessionary conditions in industrialised countries led to a decline in the volume of world trade and the exports of some of the major items like jute manufactures and cotton fabrics were adversely affected. These developments had two effects. First, inflation deteriorated the competitiveness of the exports of developing countries. Second, recession in the industrialised countries affected the demand for goods from developing countries. These, in turn implied a slackening in the volume of exports. Thus, the growth rate of India's exports in volume terms was under 6% during the first part of the 1970s.

During 1975-76 to 1976-77, a series of internal measures, fiscal and administrative, were taken to limit the consumption

of oil products and to increase production and thus reduce the dependence on imports. Simultaneously, attempts were made to streamline export policies and procedures. However, the slackening of the international commodity boom and the continued recession in industrial countries dampened an otherwise improved growth rate, which stood at a little less than 11% during 1975-76. Growth in the quantum of exports increased to more than 18% during 1976-77 spurred by the recovery of economic activity and the replenishment of inventories in developed countries.

Soon after, exports slackened in 1977-78 in the wake of recessionary conditions and protectionist tendencies in the major industrial countries. Furthermore, the restrictions placed by the government on exports of certain agriculture based mass consumption goods also added to the worsening of real exports. This is evident from Table 5, when the volume index of exports showed a negative growth of 3.7 percent during 1977-78. Furthermore in level terms also the volume index declined during 1977-78 attaining a level of 93.2 as compared to 96.8 during 1976-77.

Though the growth rate in the quantum index of exports improved to 7.3% during 1978-79, it decelerated in 1979-80 showing a lower growth rate of 6.2%. The reasons for this sluggish performance can be attributed to both the domestic and external environment. At the domestic level, the strong pull of the highly profitable domestic market did not encourage aggressive export orientation. Further, in the area of domestic policy, the emphasis on export promotion had declined compared with the situation in the wake of the oil crisis of 1973. This was made worse by the unfavourable international trading environment compared with the past because of slower growth in world trade and an accompanying increase in protectionism. This period witnessed an increasing resort to a host of measures like quota, excessively restrictive and cumbersome quality control,

countervailing duties etc. All these non-tariff barriers limited access to developed country markets and increased the uncertainty facing exporters. The domestic economy also suffered from severe drought conditions in 1979 as well as the consequences of the global oil price rise.

During the first four years of the Sixth Plan (1980-85) exports in volume terms showed a lower growth. This was a continuation of the performance as witnessed in the latter years of 70s. This has to be viewed against the background of recessionary conditions in the world economy, continuation of protectionist tendencies in world markets and the impact of severe drought conditions in the country during 1979-80 and 1982-83. In volume terms, world trade grew by just 1.5 percent in 1980, stagnated in 1981, and then fell by 2 percent in 1982. (Economic Survey 1984-85). Some of the important markets for India in West Asia faced disturbed conditions and there was also a slowing down in economic activity in these countries, following the decrease in the volume of their oil exports and international prices. Further, lower purchases by East European countries contributed to the slow growth in exports.

The government undertook a series of corrective measures during the course of 1985-86 and 1986-87 to boost the growth of exports and curb the increase in imports. A wide range of exports enhancing initiatives was launched during this period. These resulted in a marked improvement in the growth of real exports which was significant in the face of a sluggish expansion in the volume of world trade. The global economic environment was also affected by the stock market crisis of 1987 and the turmoil in the world foreign exchange market with the US dollar declining against majority of the currencies. On the domestic front, the unprecedented drought of 1987 exerted strain on the balance of payments. It also necessitated additional imports of essential imports and reduced exports of agro-based commodities.

In the early part of the 90s, the country passed through a severe balance of payments crisis. The Gulf crisis coupled with the recessionary trends discernible in some major industrial economies constrained the export growth during 1990-91. The early 90s also witnessed political and economic upheavals in Eastern Europe. These economies had earlier provided a sheltered market for a large variety of Indian goods. The exports growth decelerated during the early 90s as shown in Table 5.

Other factors which accounted for the poor performance in the growth rate of real exports included import curbs introduced during the early 90s in response to the foreign exchange shortage which affected export-related imports. Further, movements in the exchange rate, which were broadly supportive of exports since 1986-87 became adverse thus affecting competitiveness of exports. There was also a slowdown in the expansion of world trade and recessionary conditions in some major industrial countries. Exports were also adversely affected by tight monetary policy that affected export credit and imports of raw materials and components. Moreover, the growth in industrial production could not be sustained once the accumulated inventories were drawn down resulting in a decline in industrial production during 1991-92 thus affecting export surpluses available.

During 1993-94, the growth rate of real exports recovered, reflecting in part the strength of the reforms in trade and industrial policies adopted since 1991. This recovery shows that exports responded positively to the removal of the anti-export bias of a protectionist environment. This was bolstered by the resurgence in world output, which increased by 3.6 percent during 1994 after a growth of 2.5 percent in 1993. (Economic Survey 1995-96)

This recovery, however, was not sustained for long as there was a rapid decline in the growth from 1996-97 to 1997-

98. This decline in export performance must be viewed in the backdrop of a steep decline in non-POL import growth during 1996-97. The decline reflects a modest slowdown in industrial activity compared to the economic dynamism of earlier years. This has been compounded by several external developments, including a fall in import demand by industrial countries, regional groupings of the developed economies and the effect on exports of large movements in cross country exchange rates.

Apart from these, a noticeable decline in the growth of world trade in 1996 and 1997 and appreciation of the rupee in REER terms were other contributory factors. The unprecedented depreciation of the currencies of the competitor countries in Southeast Asia like the Philippines, Indonesia and Thailand was another factor responsible for the decline.

The above discussion has mainly focused on movements in the volume and value of exports. Fluctuations in the unit value index of exports are also an important gauge of changes in exports. For instance, the index grew sharply by more than 20% during 1973-74 and 1974-75 (Table 4). This reflected the inflation in the industrial countries as a result of the oil price shock of 1973. However, the second half of the 70s witnessed a deceleration in the unit value index. This was mainly due to the recessionary conditions in the industrialized countries. Furthermore, there was a slackening of the international commodity boom leading to a fall in the international prices of important items like tea, coffee & cashew kernels. The index improved (prices of our exports rose) in 1979 following the second oil price shock.

The slow growth in the unit value in the early 1980s was due to the contraction in world demand during this period as discussed earlier. During 1985-86, the marked fall in the international prices of some of the commodities of export interest

to India led to a fall in growth of the unit value index. In the 90s, the index began with a low growth rate of less than 6 percent during 1990-91 before accelerating to over 26 percent during 1991-92. This followed the devaluation of the rupee in June/July 1991 by about 18% vis-à-vis the basket of 5 currencies. However, it slowed down thereafter with the average annual growth rate being 12.6 percent during the first half of 90s. During this period, there was a sharp decline in the international prices of manufactured goods including gems, jewellery and textile products, India's major export items.

III.4 Evaluation of the Leading Index: Lead Profiles

The hallmark of a cyclical leading indicator is the property that its cyclical turning points lead cyclical turning points in the economy. However, there are no well-known methods to test whether these leads are statistically significant. Furthermore, the leading index for exports covers a small number of cycles. Thus the evaluation of its cyclical leads at turning points by parametric statistical methods is not easy. The need to make a heroic assumption that the probability distribution of the leads has a standard functional form also precludes the use of parametric tests of statistical significance. The solution is a series of non-parametric statistical tests, which yield the lead profile (Banerji, 2000).

The lead profile is a graphical depiction of the leads in strictly probabilistic terms, that aids meaningful comparisons between two indices or an index and the reference cycle. It can be graphically represented in bar charts or "lead profile charts". The question answered by this chart is whether the difference between the leads of the two indices (or an index and the reference cycle) is statistically significant.

The advantage of lead profile charts is that these use as input just the information on the length of the leads at each

turning point. However, by gleaning statistical inferences from the data rather than relying solely on averages, and by displaying the results graphically, they afford additional insights into the significance of leads.

Another major advantage of lead profiles lies in the explicit statistical inferences that can be made about the significance of leads without making any assumptions about the probability distribution of leads, or any restrictions on sample size. These inferences can be made about the leads of a given cyclical indicator over a reference cycle, such as a set of business cycle turning points. They can also be made about the leads of one cyclical indicator over another, to assess whether one has significantly longer leads than the other. Moreover, it is convenient to put lead profiles in the form of bar charts, for easy and effective visual appraisal of the significance of lengths of leads[5].

Figures 7-12 show the lead profiles of the composite leading index vs. alternative reference cycles. Figures 7 and 8 show the leading index vis-à-vis the quantum index level and growth rate reference cycles respectively and are based on the leads shown in Tables 9 and 10. The first bar represents a test of the null hypothesis that the lead of the composite index is zero months, against the alternative that it is greater than zero, i.e. at least one month. Analogously, the second bar represents another test, of the null hypothesis that the lead is one month, against the alternative that it is greater, i.e., at least two months. Figure 7 based on the level shows that the null hypothesis of zero lead cannot be rejected. The growth rate results are more encouraging (Figure 8) with the confidence level over 90% for leads up to 3 months.

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[5] Computation of the lead profile is discussed in Appendix B.

Figure 9 depicts the lead profile of the level of the leading index of exports vs. the level of the unit value of exports. The confidence level is below 90% for all leads. Figure 10 represents the lead profile of the growth rates of these two variables. The confidence level is close to 100% up to 9 months and more than 90% up to 14 months.

Figure 11 gives the lead profile of the level of the leading index of exports vs. the total value of exports. The confidence level is below 80% for all months indicating that the leads are statistically insignificant. The growth rate lead profile in Figure 12 shows that the confidence level is above 95% for up to 4 months and more than 90% for an additional 2 months.

On the basis of the lead profiles, we can conclude that in general, the performance of the growth rates is better compared to the level variables. Further, in order of performance of the variables, the growth rate of the unit value index ranks first followed by the growth rate of the total value of exports.

PART IV

SUMMARY AND CONCLUSIONS

The findings of the study indicate that the level of the leading index for exports leads the quantum index, the unit value index, and the total value index. Furthermore, the growth rate of the leading index leads the growth rates of each of the above three target variables. These findings are very encouraging considering how volatile the series are. The results are also robust in the sense that the standard deviations of the leads are typically low, under 10 months for the overall lead.

The lead profile analysis shows that the lead profile of the leading index of exports vs. the reference cycle of the growth rate of the unit value index performs best.

Several limitations of the study merit mention. First, the 15 countries for which we have long leading indices account for roughly half of India's exports. Other countries like Russia or Middle Eastern nations are not included. This can distort the results substantially. For some of these countries, the price of oil may be a useful indicator of their demand cycle and can be combined (in future research) with the 15 leading indices to construct a comprehensive leading index for exports.

Export performance was also affected by tariffs and quotas. As noted by Srinivasan (2000, p.72), restricting imports through tariffs and quotas, that is explicit and implicit taxation of imports, is equivalent to taxation of exports. Moreover, the exchange rate was overvalued for long periods of time. In order to offset the negative impact on exports of import taxes and exchange rate overvaluation, measures of export subsidization were implemented. Srinivasan (2000, p.73), however, notes that

the "...overall impact of export subsidization in offsetting the bias against exports, created by the import control regime, was at best modest and incomplete, and at worst negligible." In light of all these distortions, it is actually creditable that the level and the growth rate of the leading index for exports perform reasonably well.

It is also worth noting that there was a significant volume of barter trade (especially with the Soviet Union/Russia), which may have been driven less by exchange rates or the strength of foreign demand than by the size of Indian import needs from the foreign country. This, in turn, would have determined the size of exports. For instance, bilateral trade with Russia was $5.5 billion in 1960 – a significant level – but fell to $1.6 billion last year (Financial Times, October 4th, 2000). Again, the performance of the leading index is creditable given that the components of the leading index may not have incorporated these changes in trade.

Moreover, the composition of exports may also adversely affect the predictive ability of the leading index for exports and its growth rate. For instance, especially in the past, a significant portion of India's exports have included items like tea, the demand for which may not have much to do with the business cycle in the consuming countries. We therefore expect the performance of the leading index for exports to improve in the future with India moving into the cyclically sensitive (investment-driven) high-tech areas.

A major limitation of the present study is the long publication lags in the target variables. At the time of writing, the most recent export related data measuring the target variables are available up to December 1999 only, implying more than an eighteen months lag in the availability of data. For a leading index to be useful, meaningful and reliable, data

must be available on a timely basis. Note that the components of the leading index (15 country leading index and REER) are available on a timely basis. The lag is in the availability of the target variables movements in which are predicted by the leading index. We hope that data availability will improve in the near future.

The fact that only demand factors have been taken into account in the construction of the leading index also merits mention. This, however, can be justified on the following grounds. First, supply factors are generally not cyclical. Second, apart from those that are not predictable (e.g. shocks), supply factors usually change more slowly than demand. This means that demand factors are generally the drivers in economic cycles. Finally, with further liberalization of trade, demand factors are expected to become more dominant than supply constraints, implying that they will primarily drive the cycles.

In sum, the construction of the leading index for exports in the past was beset with data limitations and other problems experienced by a developing country dominated by the public sector and import-substituting industrialisation. Nevertheless, the index performed reasonably well and its performance can only be expected to improve further in the future.

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.

APPENDIX B

This appendix describes the concept and construction procedure of the lead profile to evaluate leading indicators.

Evaluation of a Leading Indicator: The Lead Profile[6]

Testing for Cyclical Leads

It has long been recognized that leading indicators can be a valuable forecasting tool for forecasting cyclical turning points. They have, however, not always been properly evaluated. One method of evaluating leading indicators that has gained some popularity in recent years is the Granger causality test. It is thus interesting to note what Granger and Newbold (1986) have to say about the difficulty of evaluating the index of leading indicators:

"The index of leading indicators has become a widely quoted and generally trusted forecasting tool. However, it has been rather misinterpreted. The index is intended only to forecast the timing of turning points and not the size of the forthcoming downswing or upswing nor to be a general indicator of the economy at times other than near turning points. Because of this, evaluation of the index of leading indicators by standard statistical techniques is not easy."

This difficulty in evaluation has often led to flawed assessments of the performance of leading indicators, not necessarily based on their ability to anticipate turning points. Part of the problem has been a lack of familiarity with the standard methods of identifying turning points. Yet, since leading indicators are meant primarily to forecast business cycle turning points,

[6] This section is based on Banerji (2000).

the identification of turning points in time series is a sine qua non for an appropriate evaluation of their forecasting performance. In fact, an objective algorithm for turning point identification, based on a systematic codification of the judgmental procedures used for decades at the NBER, was devised almost three decades ago (Bry and Boschan, 1971), shortly after the creation of the index of leading indicators. The Bry-Boschan procedure has certainly stood the test of time.

Geoffrey Moore, who helped create the index of leading indicators (Moore and Shiskin, 1967), used the Bry-Boschan procedure extensively in the decades following its creation (e.g., Klein and Moore, 1985). Other users have included King and Plosser (1989), who provide a description of the procedure. Watson (1994) points out that the Bry-Boschan procedure provides a good way to define turning points since it is based on objective criteria for determining cyclical peaks and troughs.

The objective (though not mathematically simple) definition of turning points given by Bry and Boschan's algorithmic formulation of the classical NBER procedure makes it possible to evaluate the performance of leading indicators in terms of an objective measure of the leads of leading indicators at turning points. In that sense, the Bry-Boschan procedure permits a more appropriate evaluation of the performance of leading indicators.

Given the cyclical turning points of a potential leading indicator, it is possible to measure the lead of that indicator at each business cycle turning point. However, many leading indicators cover only a small number of cycles. Thus the evaluation of leading indicators by parametric statistical methods is usually constrained by the limited number of cyclical turning points covered by the data. In addition, the need to make a heroic assumption that the probability distribution of the leads

has a standard functional form also precludes the use of parametric tests of statistical significance.

This appendix suggests a simple nonparametric test to evaluate the cyclical leads of leading indicators, and describes lead profile charts that graphically depict these leads in probabilistic terms, to aid in the selection and evaluation of leading indicators.

The Problem

A number of considerations go into the evaluation of any time series as a cyclical leading indicator. The main issue is the evaluation of the magnitude of the leads of a leading indicator compared with a reference cycle (such as the business cycle) at cyclical turns as well as their leads compared with one another when two or more series are being compared. In all of these cases, the magnitude (and even the direction) of the lead may vary from one turn to the next. The problem, then, is the statistical significance of the leads, or of the difference in leads, as the case may be.

We have cited Granger and Newbold (1986) who suggest, in effect, that standard statistical approaches to the evaluation of leading indicators may be fraught with problems. The simpler classical approach of just measuring the mean and standard deviation of the leads does not result in tests of statistical significance without an assumption that the probability distribution of the leads has a standard functional form. Thus, no tests of significance can usually be performed. Under such circumstances, simple nonparametric tests may be the most appropriate solution.

Appropriate Nonparametric Tests

Nonparametric tests are often called “distribution-free” because they do not assume that the observations were drawn

from a population distributed in a certain way, e.g., from a normally distributed population. These tests also do not require the large samples needed to reliably estimate parameters of distributions assumed in parametric tests. Such tests should therefore be uniquely suited to testing the significance of leads, which may be small in number, and for which the probability distribution function is quite unknown.

Since the leads in question are differences in timing at cyclical turns (between a pair of indicators, for example), the appropriate nonparametric tests are those applicable to matched pairs of samples. The most powerful tests in this class assume interval scaled data (like temperature in degrees Celsius) where equal intervals at any point in the scale imply equal differences. Leads measured in months or quarters are at least interval scaled, so such tests can be used with data on leads.

The most appropriate test to assess the significance of leads within this class is the Randomization test for matched pairs. This test has a power-efficiency of 100%, because it uses all the information in the sample (Siegel, 1956), but it does not lend itself to manual computation for sample sizes greater than about nine pairs. In such cases, a simple computer program can be used.

The Randomization Test for Matched Pairs

The Randomization test (Fisher, 1935) is a simple and elegant way to test the significance of leads. The first step is to calculate the difference in timing at turns, that is, the leads of one indicator over another, or over the business cycle turning points. The null hypothesis, that these differences are not statistically significant, is to be tested against the alternative hypothesis that the leads are significant.

Now, some of the differences calculated in the first step may be positive, others negative. If the null hypothesis is true, the positive differences are just as likely to have been negative, and vice versa. So if there are N differences (from N pairs of observations), each difference is as likely to be positive as negative. Thus, the observed set of differences would be just one of 2^N equally likely outcomes under the null hypothesis.

Also, under the null hypothesis, the sum of the positive differences would, on average, equal the sum of the negative differences, so the expected sum of the positive and negative differences would be zero. If the alternative hypothesis was true, and the leads were positive and significant, the sum would very likely be positive.

The second step, therefore, is to sum the differences, assigning positive signs to each difference; then to switch the signs systematically, one by one, to generate all the outcomes which result in sums as high or higher than that observed. If there are R such outcomes, then the probability of the observed outcome (or a more extreme outcome) under the null hypothesis is $(R/2^N)$. In other words, the null hypothesis can be rejected at the $100(1-(R/2^N))\%$ confidence level.

An example of the manual computation involved is provided below.

Leads of a hypothetical leading indicator over business cycle troughs

The leads at troughs of this indicator compared to the business cycle troughs are 12, 4, 1, 0 and -27 months. The last figure represents a lag of 27 months. Although the convention is to use negative numbers for leads, and positive numbers for lags, it is simpler for the purpose of this exposition to think

of leads as being positive, because we are, in general, concerned with the significance of leads, not lags.

The first step is to drop the zero-month lead from the analysis; keeping this observation would make no difference to the results, as is evident from the procedure for the Randomization test. Then N = 4, and the 4 observations are (12, 4, 1, -27), which add up to a sum of S = -10.

This sum S is now compared with the sums computed by starting with all positive numbers, and switching signs one by one so that the sums are in descending order until our sum of S = 10 is reached:

12	4	1	27	Sum = 44
12	4	-1	27	Sum = 42
12	-4	1	27	Sum = 36
12	-4	-1	27	Sum = 34
-12	4	1	27	Sum = 20
-12	4	-1	27	Sum = 18
-12	-4	1	27	Sum = 12
-12	-4	-1	27	Sum = 10
12	4	1	-27	Sum = -10 = S

Since R = 9 sums out of 2^4 (i.e., 16) possible combinations are greater than or equal to -10, the probability of such an outcome under the null hypothesis (“leads not significant”) is 9/16 = 0.5625, so that the null hypothesis can be rejected only at the 100 (1-0.5625)% = 43.75% level of confidence. Hence, the null hypothesis is not rejected for leads at troughs.

Lead Profiles

So far, the discussion has focused on the confidence level at which the null hypothesis ("leads not significantly different from zero") can be rejected in favor of the alternative hypothesis ("leads significantly greater than zero months"). Now, even if it is established that the leads are significantly greater than zero months, it might be interesting to know how much greater than zero months the leads are likely to be – for example, whether the leads are also significantly greater than one month.

This is easy to determine. All one needs to do is to subtract one month from each of the differences in timing at turns (already calculated in the first step of the Randomization test). Then, as before, one finds the confidence level at which the null hypothesis is rejected in favor of the alternative hypothesis that the difference in timing at turns significantly exceeds one month.

In this way one can also determine the confidence levels for the hypotheses that the leads exceed 2,3,4, ... K months – simply by subtracting 2,3,4, ... K respectively from the original differences before performing the Randomization test. We call this full set of confidence levels a "lead profile".

The lead profile is a graphical depiction of the leads in strictly probabilistic terms, that aids meaningful comparisons between the indices. It can be graphically represented in bar charts or "lead profile charts". The question answered by this chart is whether the difference between the leads of the two indices is statistically significant.

The advantage of lead profile charts is that these use as input just the information on the length of the leads at each turning point. However, by gleaning statistical inferences from

the data rather than relying solely on averages, and by displaying the results graphically, they afford additional insights into the significance of leads.

Another major advantage of lead profiles lies in the explicit statistical inferences that can be made about the significance of leads without making any assumptions about the probability distribution of leads, or any restrictions on sample size. These inferences can be made about the leads of a given cyclical indicator over a reference cycle, such as a set of business cycle turning points. They can also be made about the leads of one cyclical indicator over another, to assess whether one has significantly longer leads than the other. Moreover, it is convenient to put lead profiles in the form of bar charts, for easy and effective visual appraisal of the significance of lengths of leads.

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Table 1

India's Share in World Exports

(US $ million)

Year	Share(%) (YOY)	5 years	5-year average
1951	2.10		
1955	1.43	1951-55	1.64
1960	1.13	1956-60	1.23
1965	0.99	1961-65	1.08
1970	0.68	1966-70	0.80
1971	0.61		
1972	0.62		
1973	0.53		
1974	0.48		
1975	0.52	1971-75	0.55
1976	0.59		
1977	0.59		
1978	0.54		
1979	0.49		
1980	0.45	1976-80	0.53
1981	0.44		
1982	0.53		
1983	0.53		
1984	0.54		
1985	0.49	1981-85	0.51
1986	0.46		
1987	0.47		
1988	0.48		
1989	0.53		
1990	0.53	1986-90	0.49
1991	0.50		
1992	0.52		
1993	0.58		
1994	0.59		
1995	0.60	1991-95	0.56
1996	0.62		
1997	0.62		
1998	0.60		
1999	0.66	1996-99*	0.62

Source: IMF International Financial Statistics Yearbook (various issues)

*: 4-year average

Table 2

Ratio of Exports to GDP

Year	Exports/GDP % (YOY)	5 years	5-year average
1950-51	6.10		
1954-55	5.55	1950-51 – 1954-55	5.74
1959-60	4.08	1955-56 – 1959-60	4.49
1964-65	3.11	1961-62 – 1964-65	3.49
1969-70	3.30	1965-66 – 1969-70	3.33
1970-71	3.35		
1971-72	3.28		
1972-73	3.64		
1973-74	3.83		
1974-75	4.28	1970-71 – 1974-75	3.68
1975-76	4.83		
1976-77	5.71		
1977-78	5.31		
1978-79	5.18		
1979-80	5.29	1975-76 – 1979-80	5.26
1980-81	4.65		
1981-82	4.60		
1982-83	4.66		
1983-84	4.44		
1984-85	4.78	1980-81 – 1984-85	4.63
1985-86	3.92		
1986-87	4.01		
1987-88	4.43		
1988-89	4.82		
1989-90	5.71	1985-86 – 1989-90	4.58
1990-91	5.73		
1991-92	6.73		
1992-93	7.17		
1993-94	8.12		
1994-95	8.19	1990-91 – 1994-95	7.19
1995-96	9.00		
1996-97	8.72		
1997-98	8.58		
1998-99	7.93	1995-96 – 1998-99*	8.56

Source: Economic Survey (various issues)

Note: Numerator is Exports in Rs crore terms. Denominator is GDPmp at current prices in Rs crore terms for the base 1993-94=100. Figures of GDPmp at current prices for base 1981-82 have been converted to base 1993-94 by using splicing factors. These figures are similar to the ones given in RBI Handbook of Statistics on Indian Economy, 1999.

*: 4-year average

Table 3

Debt-Service Ratio (%)

Year	Debt-Service Ratio(%)	Year	Debt-Service Ratio(%)
1950-51	2.7	1987-88	23.5
1965-66	24.2	1988-89	26.5
1968-69	20.5	1989-90	30.9
1976-77	10.4	1990-91	35.3
1978-79	9.1	1991-92	30.2
1979-80	8.5	1992-93	27.5
1980-81	9.3	1993-94	25.6
1982-83	10.0	1994-95	26.2
1983-84	11.6	1995-96	24.3
1984-85	12.1	1996-97	21.2
1985-86	16.7	1997-98	19.1
1986-87	22.0	1998-99	18.0

Source: CMIE-Performance of Indian Economy during Indira Gandhi's Regime, 1984 (from 1950-51 to 1978-79)

Economic Survey (various issues) (from 1979-80 to 1988-89)

RBI Handbook of Statistics on Indian Economy, 1999 (from 1990-91 to 1998-99)

Note: Data on short-term debt and estimated interest payments on NRI deposits are not available prior to 1988-89. Hence the series from 1988-89 onwards is not strictly comparable with that prior to 1988-89. Data for 1978-79 excludes debt service on account of suppliers' credits.

Debt-Service Ratio = Debt service payments as a percent of current receipts where, Debt service payments includes amortisation and interest payments with respect to external assistance (inclusive of non-government account), external commercial borrowings, IMF credits, NRI deposits and rupee debt service; and

Current receipts include gross receipts under merchandise exports and invisibles except official transfers

Table 4

Percentage Change in Unit Value Index Numbers and Terms of Trade

(1978-79=100)

Unit value index (% change)					Net TOT			5 years
Year	Exports		Imports					
	YoY%	5-year average	YoY%	5-year average	Level	YOY%	5-year average	
1955-56	-8.16		-9.23		104.48	1.18		
1959-60	0.00	-0.96	-7.00	-2.01	109.78	7.53	1.36	1955-56 – 1959-60
1964-65	1.90	1.46	2.06	1.30	110.34	-0.15	0.17	1960-61 – 1964-65
1969-70	4.00	11.48	0.00	8.72	125.00	4.00	2.65	1965-66 – 1969-70
1970-71	2.27		0.28		127.48	1.98		
1971-72	2.22		-7.08		140.24	10.01		
1972-73	11.30		4.27		149.71	6.75		
1973-74	21.48		42.98		127.20	-15.04		
1974-75	25.40	12.54	72.80	22.65	92.31	-27.43	-4.74	1970-71 – 1974-75
1975-76	7.56		17.28		84.66	-8.28		
1976-77	6.56		-2.83		92.83	9.65		
1977-78	12.19		-8.62		113.98	22.77		
1978-79	-0.30		13.64		100.00	-12.26		
1979-80	5.40	6.28	14.10	6.71	92.38	-7.62	0.85	1975-76 – 1979-80
1980-81	2.94		17.62		80.85	-12.48		
1981-82	14.38		-0.82		93.24	15.32		

(contd...)

	Unit value index (% change)				Net TOT			5 years
Year	Exports		Imports					
	YoY%	5-year average	YoY%	5-year average	Level	YOY%	5-year average	
1982-83	6.37		2.40		96.85	3.87		
1983-84	14.39		-7.70		120.03	23.94		
1984-85	12.45	10.11	28.54	8.01	105.01	-12.52	3.63	1980-81 – 1984-85
1985-86	0.59		-1.79		107.56	2.43		
1986-87	5.04		-12.22		128.69	19.65		
1987-88	8.92		14.78		122.13	-5.10		
1988-89	18.83		15.94		125.18	2.50		
1989-90	19.12	10.50	23.13	7.97	121.10	-3.25	3.24	1985-86 – 1989-90
1990-91	5.75		17.21		109.26	-9.78		
1991-92	26.32		15.47		119.54	9.41		
1992-93	14.07		7.09		127.34	6.53		
1993-94	12.48		-1.15		144.90	13.79		
1994-95	4.32	12.59	-0.79	7.56	152.37	5.16	5.02	1990-91 – 1994-95
1995-96	-2.10		8.13		137.95	-9.47		
1996-97	4.23		13.90		126.24	-8.49		
1997-98	16.78		1.10		145.82	15.51		
1998-99	3.83	5.69	0.94	6.02	150.00	2.87	0.11	1995-96 – 1998-99*

(concld.)

Primary Source : DGCI&S, Calcutta;

Secondary Source : Economic Survey (various issues) and Report on Currency and Finance (various issues)

Note : Data for different base periods are spliced to base 1978-79.

*: 4-year average

Table 5

Percentage Change in Nominal and Real Exports

	Exports (% change)				Imports (% change)				Volume index (% change)				5 years
Year	US$mn		Rs crore		US$mn		Rs crore		Exports		Imports		
	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	
1951-52	17.42		18.15		45.48		46.38						
1954-55	10.68	0.34	11.68	0.61	13.84	6.42	14.75	6.73	5.00	5.00	18.28	5.64*	1951-52 - 1954-55
1957-58	-6.99		-7.27		23.43		23.07		8.18		13.87		
1959-60	10.17	1.89	10.15	1.70	6.05	7.36	6.07	7.18	7.00	2.22	10.00	7.43	1955-56 - 1959-60
1964-65	2.53	4.97	2.90	5.11	9.97	7.09	10.30	7.22	4.76	4.48	8.15	6.07	1960-61 - 1964-65
1966-67	-3.84		42.84		-0.71		47.48		-4.03		-3.25		
1967-68	-2.58		3.63		-9.13		-3.37		2.52		11.41		
1969-70	4.36	2.04	4.05	12.61	-16.87	-5.49	-17.13	5.30	0.00	1.76	-16.00	-2.28	1965-66 - 1969-70
1974-75	30.07	17.84	31.95	19.18	50.73	24.35	52.93	25.70	6.04	5.83	-11.47	4.17	1970-71 - 1974-75
1976-77	23.32		27.40		-6.69		-3.63		18.48		0.13		
1977-78	9.79		5.17		23.85		18.64		-3.72		31.41		
1978-79	10.48		5.88		18.05		13.14		7.30		0.00		
1979-80	13.89	13.85	12.09	14.36	36.40	15.80	34.24	15.78	6.20	7.82	16.40	9.28	1975-76 - 1979-80
1980-81	6.78		4.57		40.17		37.25		1.79		18.47		
1981-82	2.57		16.32		-4.38		8.44		1.85		9.21		
1982-83	4.63		12.77		-2.55		5.03		5.99		2.66		

(contd...)

	Exports (% change)				Imports (% change)				Volume index (% change)				5 years
Year	US$mn		Rs crore		US$mn		Rs crore		Exports		Imports		
	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	YoY	5-year avg	
1983-84	3.76		11.00		3.54		10.76		-3.17		19.92		
1984-85	4.54	4.46	20.19	12.97	-5.87	6.18	8.23	13.94	6.90	2.67	-15.80	6.89	1980-81 - 1984-85
1985-86	-9.86		-7.23		11.48		14.73		-7.86		16.78		
1986-87	9.45		14.29		-2.12		2.23		8.98		16.46		
1987-88	24.05		25.88		9.09		10.69		15.42		-3.53		
1988-89	15.56		29.08		13.65		26.93		8.64		9.47		
1989-90	18.91	11.62	36.70	19.74	8.83	8.19	25.12	15.94	14.99	8.03	1.61	8.16	1985-86 - 1989-90
1990-91	9.22		17.70		13.46		22.28		10.98		4.35		
1991-92	-1.53		35.29		-19.37		10.77		7.47		-4.08		
1992-93	3.76		21.90		12.73		32.44		6.86		23.68		
1993-94	19.97		29.92		6.51		15.35		15.52		16.70		
1994-95	18.40	9.96	18.53	24.67	22.95	7.25	23.08	20.78	13.67	10.90	24.07	12.94	1990-91 - 1994-95
1995-96	20.76		28.64		28.00		36.35		31.29		26.08		
1996-97	5.26		11.72		6.69		13.24		7.16		-0.58		
1997-98	4.59		9.50		6.01		10.98		-6.27		9.83		
1998-99	-5.11	6.38	7.42	14.32	2.18	10.72	15.67	19.06	3.37	8.89	14.57	12.47*	1995-96 - 1998-99
1999-2000	13.19	7.74	16.58	14.77	11.38	10.85	14.72	18.19					1995-96 - 1999-00

(concld.)

Primary Source: DGCI&S, Calcutta; Secondary Source: Economic Survey (various issues) and Report on Currency & Finance (various issues)

Note: Data for different base periods for volume index are spliced to base 1978-79; *: 4-year average.

Table 6

Percentage Change in REER and NEER Indices

(36 country bilateral weights, 1985=100)

	Export-Based Weight				Trade-Based Weight			
	REER		NEER		REER		NEER	
	YoY%	5-year avg	YoY%	5-year avg	YoY%	5-year avg	YoY%	5-year avg
1961	-0.76		1.19		-0.71		0.50	
1962	1.10		0.65		1.55		1.03	
1963	-0.51		-0.06		-0.39		-0.07	
1964	5.70		1.05		5.95		0.55	
1965	2.85	1.67	0.67	0.70	3.58	1.99	0.45	0.49
1966	-18.28		-24.09		-18.21		-23.87	
1967	-7.75		-16.78		-7.62		-16.62	
1968	0.44		2.51		0.36		2.05	
1969	-5.54		0.15		-5.25		0.10	
1970	0.27	-6.17	-0.02	-7.64	0.62	-6.02	0.04	-7.66
1971	-6.67		-6.09		-8.75		-8.20	
1972	-2.80		-5.20		-2.86		-5.62	
1973	-1.30		-7.02		-1.83		-7.64	
1974	6.95		-3.54		6.65		-4.02	
1975	-9.88	-2.74	-1.83	-4.74	-10.48	-3.45	-2.41	-5.58
1976	-12.20		-1.96		-12.92		-2.14	
1977	-0.85		0.31		-0.94		0.34	
1978	-6.62		0.06		-6.30		0.02	
1979	3.03		0.79		2.44		-0.06	
1980	10.95	-1.14	4.52	0.74	11.46	-1.25	4.34	0.50
1981	-1.30		0.38		0.19		1.29	
1982	-3.88		1.07		-3.71		1.20	
1983	1.26		-0.43		1.82		0.34	
1984	-2.20		-3.80		-1.51		-2.78	

(contd...)

	Export-Based Weight				Trade-Based Weight			
	REER		NEER		REER		NEER	
	YoY%	5-year avg	YoY%	5-year avg	YoY%	5-year avg	YoY%	5-year avg
1985	-1.63	-1.55	-2.75	-1.11	-1.87	-1.02	-2.22	-0.43
1986	-7.99		-11.47		-7.85		-11.32	
1987	-7.12		-7.57		-7.29		-7.84	
1988	-3.94		-6.09		-3.84		-5.73	
1989	-5.45		-6.23		-4.60		-5.88	
1990	-3.97	-5.69	-5.19	-7.31	-2.27	-5.17	-4.50	-7.05
1991	-13.40		-19.38		-12.35		-18.73	
1992	-6.23		-14.31		-3.96		-12.54	
1993	-4.41		-8.26		-6.58		-9.67	
1994	6.84		-0.97		7.11		-0.88	
1995	-1.68	-3.78	-7.23	-10.03	-1.66	-3.49	-7.37	-9.84
1996	-2.19		-5.18		-2.19		-5.46	
1997	6.61		3.53		7.09		3.81	
1998	-2.79	0.54*	-7.17	-2.94*	-2.33	0.86*	-6.94	-2.86*

(concld.)

Source : RBI Handbook of Statistics on Indian Economy, 1999 and RBI Bulletin, July 1993. The official exchange rate is used from January 1975 to February 1992. Since March 1992, the FEDAI indicative rate is used.

Table 7

Normalised weights for constructing REER and NEER Indices for India (%)

S. No.	Country	Export based	Total trade
1	USA	23.63	20.16
2	UK	10.77	10.6
3	Germany	8.62	10.25
4	Japan	16.2	13.49
5	France	3.63	3.94
6	Italy	3.79	3.16
7	Switzerland	2.08	1.71
8	Australia	2.01	2.63
9	S.Korea	1.24	1.49
10	Mexico	0.09	0.23
11	Canada	1.56	2.64
A.	**Subtotal (1 to 11)**	73.62	70.3
12	Belgium	3.32	5.28
13	Netherlands	3.41	2.92
14	Argentina	0.06	0.22
15	Bangladesh	1.87	0.82
16	Brazil	1.17	1.63
17	China	0.71	0.89
18	Colombia	0.01	0.04
19	Egypt	1.66	0.92
20	Indonesia	1.05	0.64
21	Israel	0.38	0.32
22	Kenya	0.51	0.27
23	Malaysia	1.13	2.48
24	Pakistan	0.28	0.34
25	Philippines	0.26	1.02
26	Saudi Arabia	3.25	5.85
27	Singapore	2.42	2.85
28	Sri Lanka	1.45	0.66
29	Thailand	0.95	0.68

(contd...)

S. No.	Country	Export based	Total trade
30	Turkey	0.21	0.31
31	Yugoslavia	0.75	0.64
32	Nigeria	0.8	0.38
33	Sudan	0.61	0.34
34	Myanmar	0.1	0.18
35	Guatemala	0.01	0
36	Uruguay	0.02	0.01
B.	**Subtotal (12 to 36)**	26.39	29.69
Total (A+B)		**100.01**	99.99

(concld.)

Source : Reserve Bank of India Bulletin, July 1993

Note : The first 11 countries are also included in the 15-country leading index. The countries included in the 15-country leading index but not included in the 36-countries for REER and NEER are Spain, Sweden, New Zealand, and Taiwan.

Table 8A

Share in India's Exports (%, Rs crores) of G-7 Trading Partners Included in the 15-Country Leading Index

Year	USA	Canada	Japan	France	Germany	UK	Italy	Total G-7
1955-56	14.31	2.30	4.96	1.17	2.45	27.28	0.92	53.39
1960-61	15.97	2.74	5.50	1.37	3.10	26.87	1.45	56.99
1964-65	18.00	2.14	7.46	1.45	2.17	20.50	1.23	52.96
1965-66	18.25	2.51	7.05	1.38	2.25	17.99	1.05	50.47
1969-70	16.84	1.86	12.70	1.54	2.12	11.68	0.91	47.65
1970-71	13.49	1.82	13.22	1.17	2.08	11.07	0.91	43.78
1974-75	11.26	1.32	8.92	2.58	3.18	9.37	1.56	38.21
1975-76	12.59	1.04	10.58	2.08	2.92	10.01	1.96	41.18
1976-77	11.07	0.97	10.58	3.46	4.47	10.13	2.31	43.00
1977-78	12.52	0.85	9.36	2.70	4.53	9.71	1.87	41.53
1978-79	13.48	0.84	10.39	3.07	4.77	9.22	2.39	44.17
1979-80	12.57	0.98	10.02	3.05	5.91	7.92	3.32	43.77
1980-81	11.09	0.92	8.91	2.19	5.74	5.89	2.26	37.00
1981-82	11.79	0.86	8.84	1.90	4.50	5.38	2.02	35.28
1982-83	10.53	0.66	2.65	1.66	3.85	4.78	1.59	25.72
1983-84	14.98	0.95	8.48	1.64	4.17	5.04	1.68	36.94
1984-85	15.04	1.12	8.76	1.63	4.16	5.22	1.81	37.73
1985-86	18.12	1.21	10.68	1.86	4.71	4.81	1.89	43.29
1986-87	18.72	1.10	10.72	2.18	5.89	5.62	2.50	46.72
1987-88	18.63	1.06	10.30	2.42	6.76	6.48	3.18	48.81

(contd...)

Year	USA	Canada	Japan	France	Germany	UK	Italy	Total G-7
1988-89	18.43	0.97	10.65	2.11	6.11	5.70	2.67	46.63
1989-90	16.17	0.95	9.87	2.31	6.41	5.78	2.75	44.24
1990-91	14.73	0.86	9.34	2.35	7.83	6.53	3.07	44.72
1991-92	16.35	1.06	9.24	2.38	7.11	6.37	3.25	45.76
1992-93	18.97	1.03	7.75	2.54	7.70	6.55	3.36	47.89
1993-94	17.98	1.03	7.83	2.27	6.92	6.20	2.72	44.94
1994-95	19.07	1.01	7.70	2.21	6.64	6.42	3.26	46.30
1995-96	17.36	0.96	6.97	2.35	6.22	6.32	3.19	43.37
1996-97	19.59	1.05	5.99	2.14	5.66	6.12	2.79	43.34
1997-98	19.43	1.24	5.42	2.17	5.49	6.12	3.19	43.06
1998-99	22.07	1.44	4.97	2.54	5.67	5.74	3.21	45.63

(concld.)

Primary Source : DGCI&S, Ministry of Commerce

Secondary Source : RBI Handbook of Statistics on Indian Economy, 1999; Report on Currency & Finance (various issues) and Statistical Abstract of India (various issues).

Note : Figures given in IMF, Direction of Trade Statistics Yearbook are mainly based on those reported by a country's compiling agency. Hence, the figures reported here are similar to the ones provided in IMF-DOTS, given that DGCI&S, Ministry of Commerce is the compiling agency for India.

Table 8B

Share in India's Exports (%, Rs crores) of 7 Trading Partners out of Remaining 8 Included in the 15-Country Leading Index

Year	Spain	Switzerland	Sweden	Australia	New Zealand	Mexico	Korea	Total-14
1955-56	0.08	0.16	0.03	4.07	0.75	0.03		58.50
1960-61	0.15	0.21	0.23	3.49	1.15	0.01		62.24
1964-65	0.14	0.54	0.21	2.45	0.66	0.03		56.99
1965-66	0.13	0.44	0.21	2.16	0.81	0.04		54.26
1969-70	0.21	0.54	0.37	1.73	0.41	0.06		50.96
1970-71	0.17	0.46	0.38	1.56	0.38	0.06		46.81
1974-75	0.25	0.49	0.47	1.98	0.62	0.03		42.05
1975-76	0.23	1.29	0.32	1.19	0.32	0.03		44.56
1976-77	0.25	1.48	0.49	1.28	0.25	0.04		46.79
1977-78	0.16	0.98	0.41	1.53	0.26	0.03		44.91
1978-79	0.26	1.69	0.41	1.55	0.22	0.02		48.33
1979-80	0.33	1.59	0.52	1.57	0.36	0.05		48.19
1980-81	0.23	1.65	0.42	1.37	0.28	0.07	0.66	41.68
1981-82	0.32	1.45	0.41	1.43	0.27	0.09		39.25
1982-83	0.38	1.14	0.34	1.07	0.21	0.04		28.89
1983-84	0.37	1.26	0.30	1.00	0.17	0.02		40.05
1984-85	0.27	0.92	0.34	1.18	0.19	0.03	0.77	41.42
1985-86	0.25	0.98	0.36	1.13	0.15	0.04	0.91	47.10
1986-87	0.52	1.28	0.44	1.17	0.17	0.03	0.85	51.19

(contd...)

Year	Spain	Switzerland	Sweden	Australia	New Zealand	Mexico	Korea	Total-14
1987-88	0.53	1.30	0.49	1.15	0.16	0.04	0.93	53.41
1988-89	0.63	1.34	0.37	1.31	0.15	0.06	0.90	51.40
1989-90	0.64	1.32	0.40	1.21	0.13	0.09	0.97	49.00
1990-91	0.87	1.23	0.49	0.99	0.12	0.12	2.02	50.56
1991-92	1.10	1.23	0.52	1.13	0.14	0.16	1.34	51.37
1992-93	1.08	1.07	0.54	1.20	0.17	0.23	0.94	53.13
1993-94	0.87	0.99	0.48	1.10	0.15	0.26	0.93	49.73
1994-95	1.02	0.94	0.56	1.32	0.21	0.30	1.26	51.91
1995-96	1.23	0.89	0.46	1.18	0.19	0.17	1.41	48.90
1996-97	1.27	0.90	0.46	1.15	0.20	0.23	1.55	49.09
1997-98	1.23	1.05	0.46	1.25	0.19	0.31	1.34	48.90
1998-99		0.97		1.17			0.83	48.61

(concld.)

Primary Source : DGCI&S, Ministry of Commerce

Secondary Source : RBI Handbook of Statistics on Indian Economy, 1999; Report on Currency & Finance (various issues) and Statistical Abstract of India (various issues).

Note : Of the countries included in the 15-country leading index, figures for Taiwan are missing.

Figures given in IMF, Direction of Trade Statistics Yearbook are mainly based on those reported by a country's compiling agency. Hence, the figures reported here are similar to the ones provided in IMF-DOTS, given that DGCI&S, Ministry of Commerce is the compiling agency for India.

Table 9

Turning Points of Leading Index for Exports vis-a vis Quantum Index of Exports

Quantum Index of Exports		Leading Index of Lead(-) Exports, Level		OR	Lag(+)	
Troughs	**Peaks**	**Troughs**	**Peaks**	**Troughs**		**Peaks**
	02/1976		03/1976			1
11/1978		06/1977		-17		
	05/1979		12/1978			-5
08/1980		08/1981		12		
	02/1989		12/1988			-2
05/1990		04/1990		-1		
	11/1991		12/1991			1
05/1992		08/1993		15		
			11/1994			extra
		07/1995		extra		
	08/1996		01/1996			-7
				Troughs		**Peaks**
					Overall	
		Average		2		-2
					0	
		Median		5.5		-2.0
					-1.0	
		Percent Lead		50		60
					56	
		Std. Deviation		14.6		3.6
					9.6	

Table 10

Turning Points of Growth Rate of Leading Index of Exports vis-à-vis Growth Rate of Quantum Index of Exports

Quantum Index of Exports, Growth Rate		Leading Index of Exports, Growth Rate		Lead(-)	OR	Lag (+)
Troughs	**Peaks**	**Troughs**	**Peaks**	**Troughs**		**Peaks**
05/1977		02/1977		-3		
	05/1979		04/1978			-13
05/1980		04/1980		-1		
			01/1983			extra
		08/1985		extra		
	08/1987		04/1986			-16
05/1988		09/1987		-8		
	02/1989		11/1988			-3
05/1990		04/1990		-1		
	11/1991		07/1991			-4
05/1992		11/1992		6		
			05/1994			extra
		07/1995		extra		
	08/1996		01/1996			-7
				Troughs		**Peaks**
					Overall	
		Average		-1		-9
					-5	
		Median		-1.0		-7.0
					-3.5	
		Percent Lead		80		100
					90	
		Std. Deviation		5.0		5.7
					6.3	

Table 11

Turning Points of Level of Leading Index of Exports vis-à-vis Level of Unit Value Index of Exports

Unit Value Index of Exports, Level		Leading Index of Exports, Level		Lead(-)	OR	Lag(+)
Troughs	**Peaks**	**Troughs**	**Peaks**	**Troughs**		**Peaks**
	05/1977		03/1976			-14
05/1978		06/1977		-11		
			12/1978			extra
		08/1981		extra		
	05/1985					miss
02/1986				miss		
			12/1988			extra
		04/1990		extra		
			12/1991			extra
		08/1993		extra		
			11/1994			extra
		07/1995		extra		
	02/1996		01/1996			-1
				Troughs		**Peaks**
					Overall	
		Average		-11		-8
					-9	
		Median		-11.0		-7.5
					—	
		Percent Lead		100		100
					100	
		Std. Deviation		—		9.2
					6.8	

Table 12

Turning Points of Growth Rate of Leading Index of Exports vis-à-vis Growth Rate of Unit Value Index of Exports

Unit Value Index of Exports, Growth Rate		Leading Index of Exports, Growth Rate		Lead(-)	OR	Lag(+)
Troughs	**Peaks**	**Troughs**	**Peaks**	**Troughs**		**Peaks**
05/1978		02/1977		-15		
	02/1980		04/1978			-22
08/1982		04/1980		-28		
	05/1983		01/1983			-4
11/1985		08/1985		-3		
	05/1988		04/1986			-25
05/1989		09/1987		-20		
	08/1990		11/1988			-21
05/1991		04/1990		-13		
	05/1992		07/1991			-10
		11/1992		extra		
			05/1994			extra
08/1996		07/1995		-13		
	02/1997		01/1996			-13
				Troughs	**Overall**	**Peaks**
		Average		-15		-16
					-16	
		Median		-14.0		-17.0
					-14.0	
		Percent Lead		100		100
					100	
		Std. Deviation		8.3		8.1
					7.8	

Table 13

Turning Points of Level of Leading Index of Exports vis-à-vis Level of Total Value of Exports

Total Value of Exports, Level		Leading Index of Exports, Level		Lead(-)	OR	Lag(+)
Troughs	**Peaks**	**Troughs**	**Peaks**	**Troughs**		**Peaks**
	02/1977		03/1976			-11
11/1978		06/1977		-17		
	05/1979		12/1978			-5
08/1980		08/1981		12		
				Troughs		**Peaks**
		Average		-3		-8
					-5	
		Median		-2.5		-8.0
					-8.0	
		Percent Lead		50		100
					75	
		Std. Deviation		20.5		4.2
					12.5	

Table 14

Turning Points of Growth Rate of Leading Index of Exports vis-à-vis Growth Rate of Total Value of Exports

Total Value of Exports, Growth Rate		Leading Index of Exports, Growth Rate		Lead(-)	OR	Lag(+)
Troughs	**Peaks**	**Troughs**	**Peaks**	**Troughs**		**Peaks**
11/1978		02/1977		-21		
	05/1979		04/1978			-13
05/1980		04/1980		-1		
			01/1983			extra
		08/1985		extra		
	02/1987		04/1986			-10
05/1988		09/1987		-8		
	02/1989		11/1988			-3
02/1990		04/1990		2		
	02/1993		07/1991			-19
05/1994		11/1992		-18		
			05/1994			extra
		07/1995		extra		
	02/1996		01/1996			-1
				Troughs		**Peaks**
					Overall	
		Average		-9		-9
					-9	
		Median		-8.0		-10.0
					-9.0	
		Percent Lead		80		100
					90	
		Std. Deviation		10.1		7.4
					8.4	

Figure 1A

Level of Leading Index of Exports vs. Quantum Index of Exports

(Shaded areas represent downturns in the quantum index of exports)

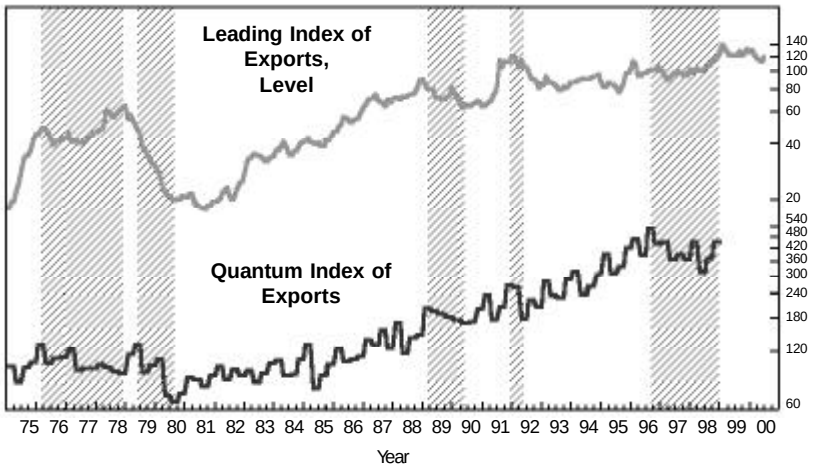

Figure 1B

Level of 15 Country Leading Index vs. Quantum Index of Exports

(Shaded areas represent downturns in the quantum index of exports)

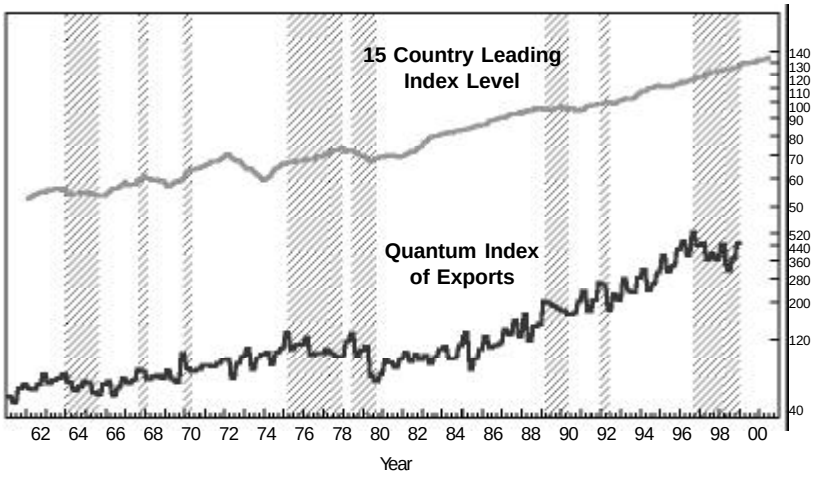

Figure 1C

Level of REER (exports-based weight) vs. Quantum Index of Exports

(Shaded areas represent downturns in the quantum index of exports)

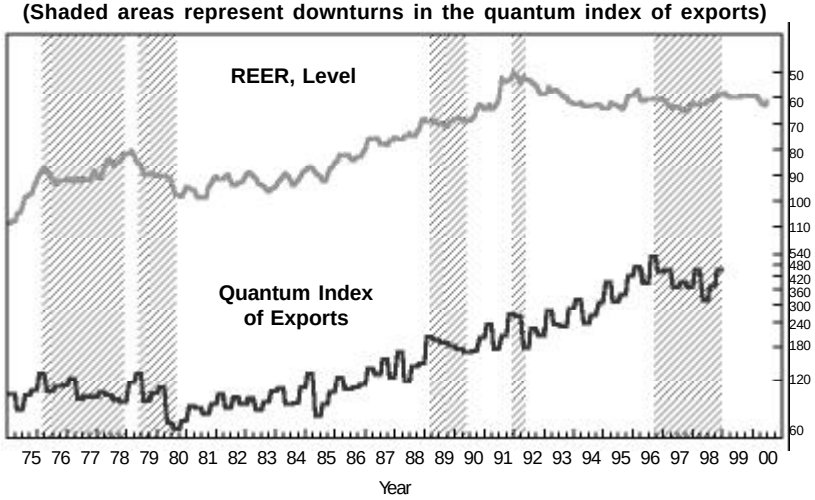

Figure 2A

Growth Rate of Leading Index of Exports vs. Growth Rate of Quantum Index of Exports

(Shaded areas represent downturns in the growth rate of the quantum index of exports)

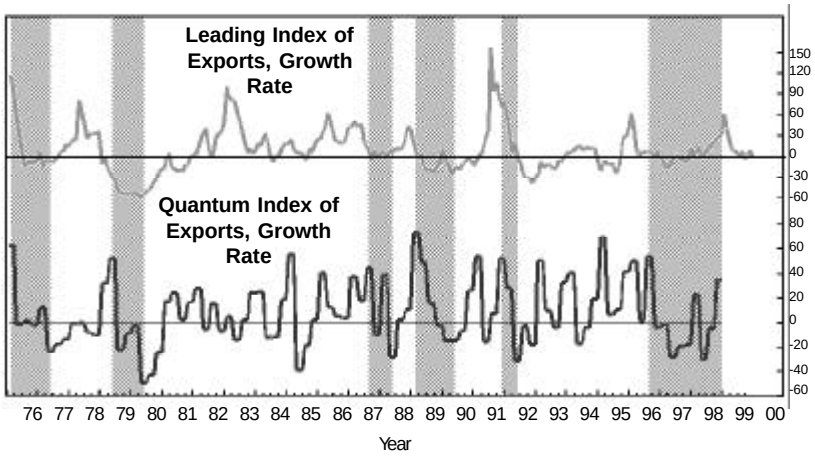

Figure 2B

Level of 15 Country Leading Index vs. Growth Rate of Quantum Index of Exports

(Shaded areas represent downturns in the growth rate of the quantum index of exports)

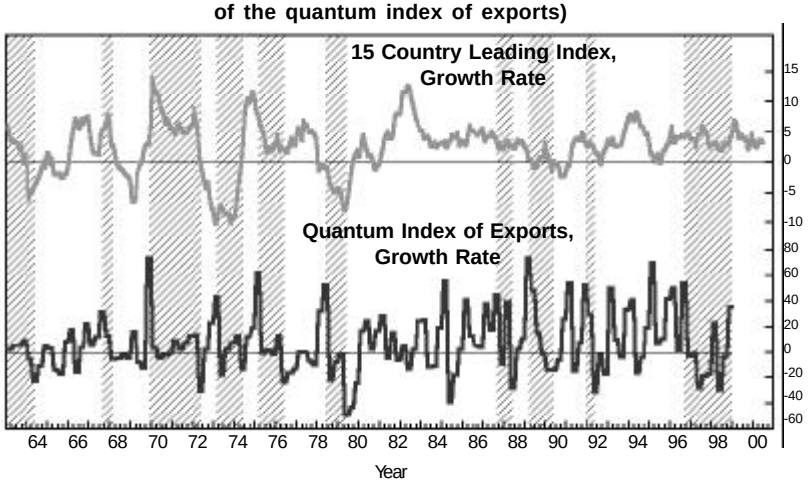

Figure 2C

Growth Rate of REER (exports-based weight) vs. Growth Rate of Quantum Index of Exports

(Shaded areas represent downturns in the growth rate of the quantum index of exports)

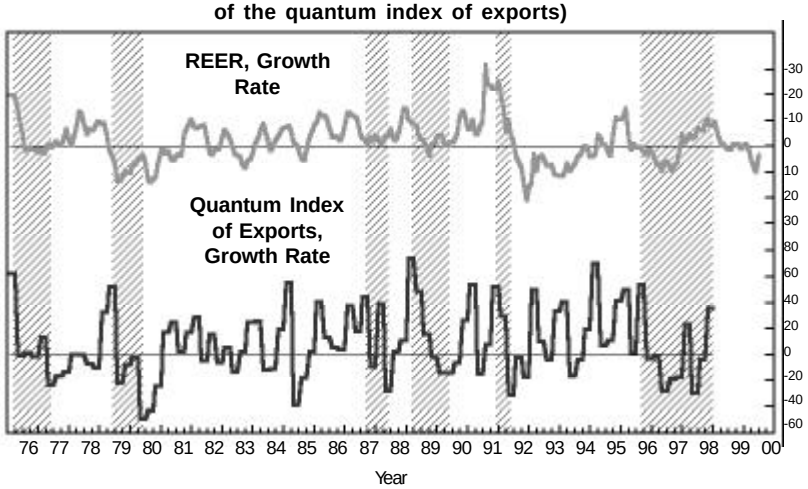

Figure 3A

Level of Leading Index of Exports vs. Level of Unit Value Index of Exports

(Shaded areas represent downturns in the level of unit value index of exports)

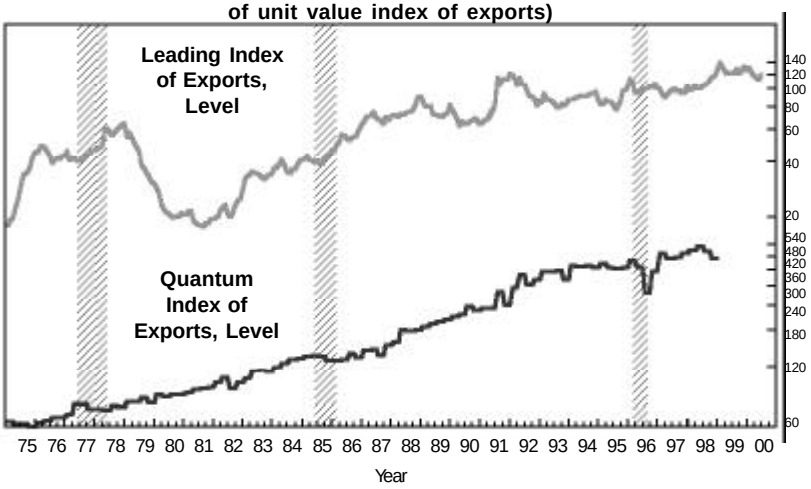

Figure 3B

Level of 15 Country Leading Index vs. Level of Unit Value Index of Exports

(Shaded areas represent downturns in the level of unit value index of exports)

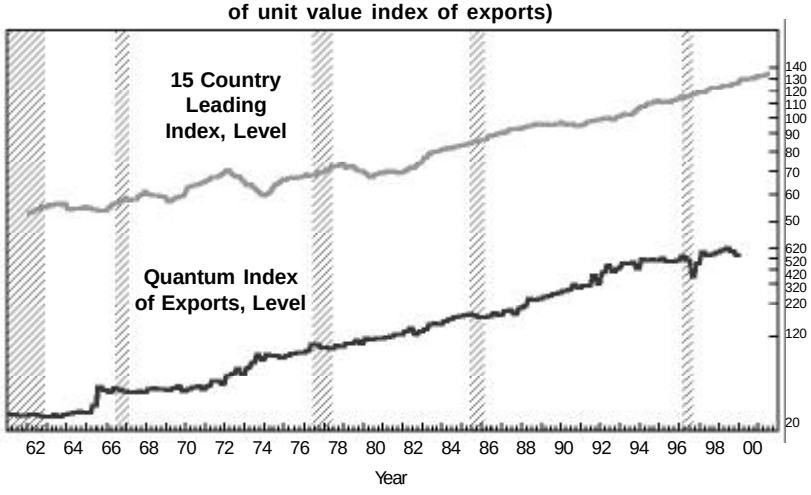

Figure 3C

Level of REER (exports-based weight) vs. Level of Unit Value Index of Exports

(Shaded areas represent downturns in the level of unit value index of exports)

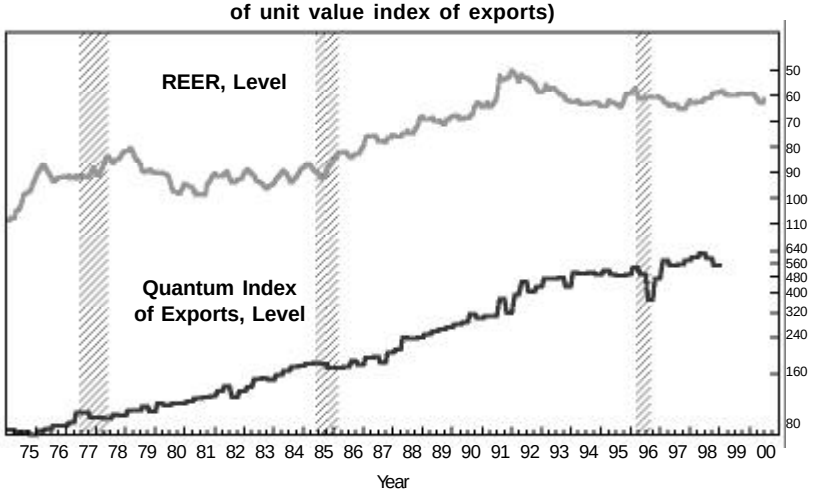

Figure 4A

Growth Rate of Leading Index of Exports vs. Growth Rate of Unit Value Index of Exports

(Shaded areas represent downturns in the Growth Rate of unit value index of exports)

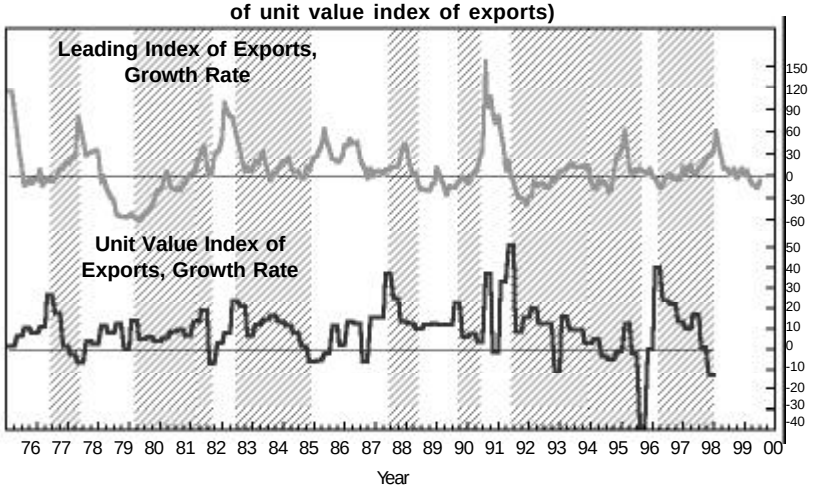

Figure 4B

Growth Rate of 15 Country Leading Index vs. Growth Rate of Unit Value Index of Exports

(Shaded areas represent downturns in the level of unit value index of exports)

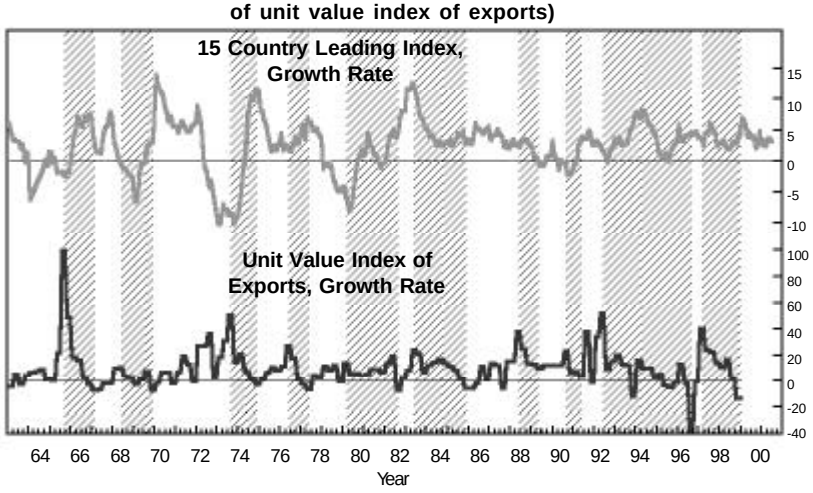

Figure 4C

Growth Rate of REER (exports-based weight) vs. Growth Rate of Unit Value Index of Exports

(Shaded areas represent downturns in the level of unit value index of exports)

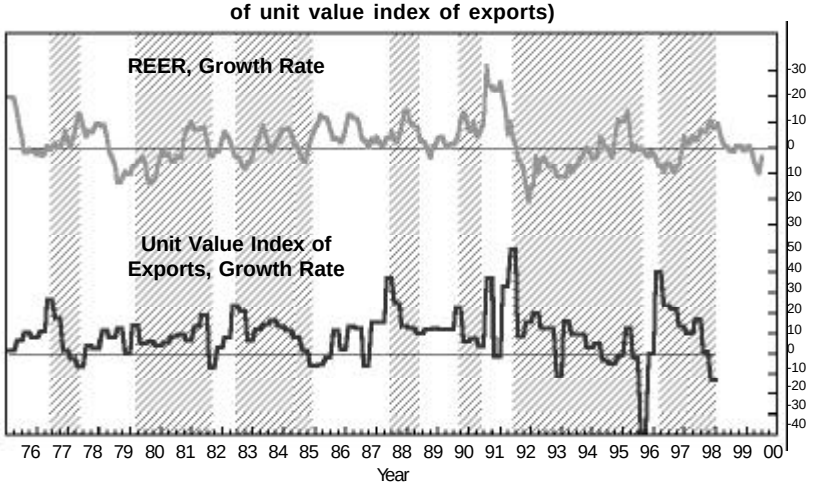

Figure 5A

Level of Leading Index of Exports vs. Level of Total Value of Exports

(Shaded areas represent downturns in the level of total value of exports)

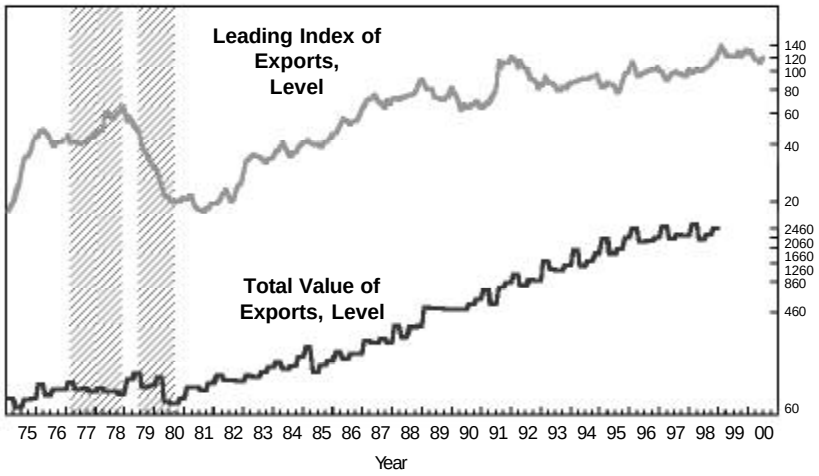

Figure 5B

Level of 15 Country Leading Index vs. Level of Total Value of Exports

(Shaded areas represent downturns in the level of total value of exports)

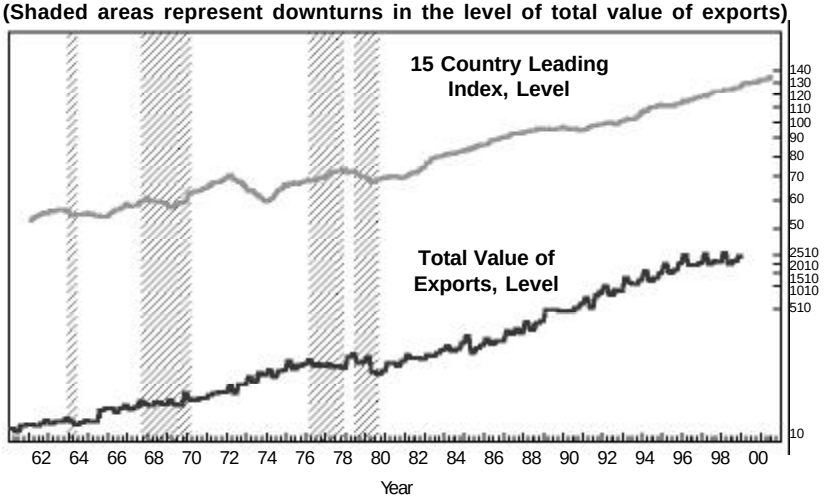

Figure 5C

Level of REER (exports-based weight) vs. Level of Total Value of Exports

(Shaded areas represent downturns in the level of total value of exports)

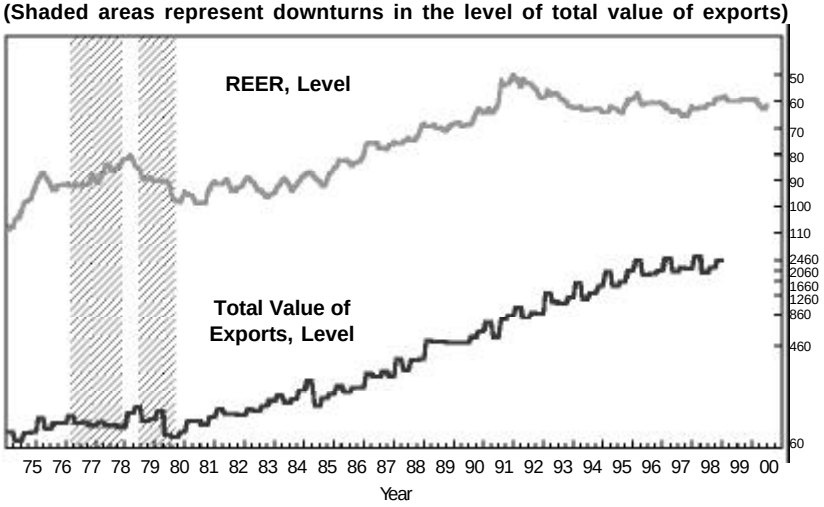

Figure 6A

Growth Rate of Leading Index of Exports vs. Growth Rate of Total Value of Exports

(Shaded areas represent downturns in the growth rate of total value of exports)

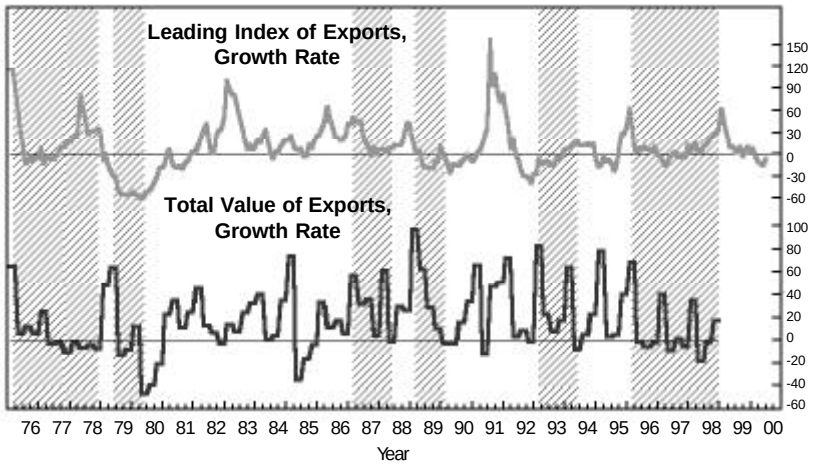

Figure 6B

Growth Rate of 15 Country Leading Index vs. Growth Rate of Total Value of Exports

(Shaded areas represent downturns in the growth rate of total value of exports)

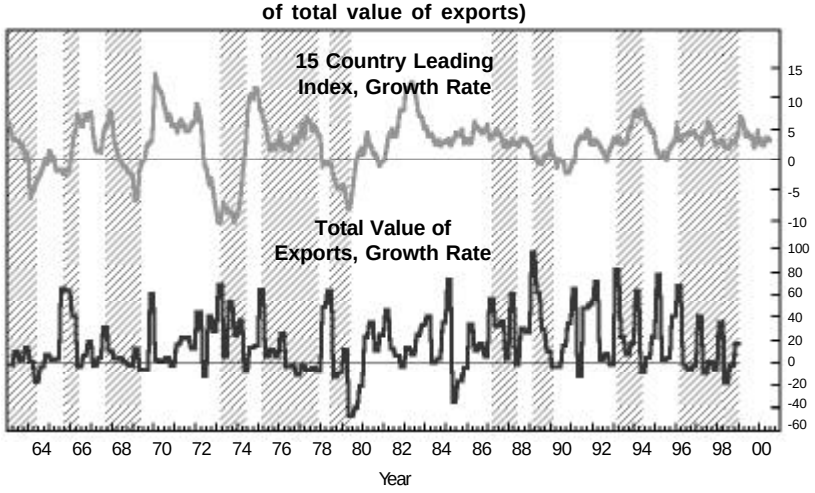

Figure 6C

Growth Rate of REER (exports-based weight) vs. Growth Rate of Total Value of Exports

(Shaded areas represent downturns in the growth rate of total value of exports)

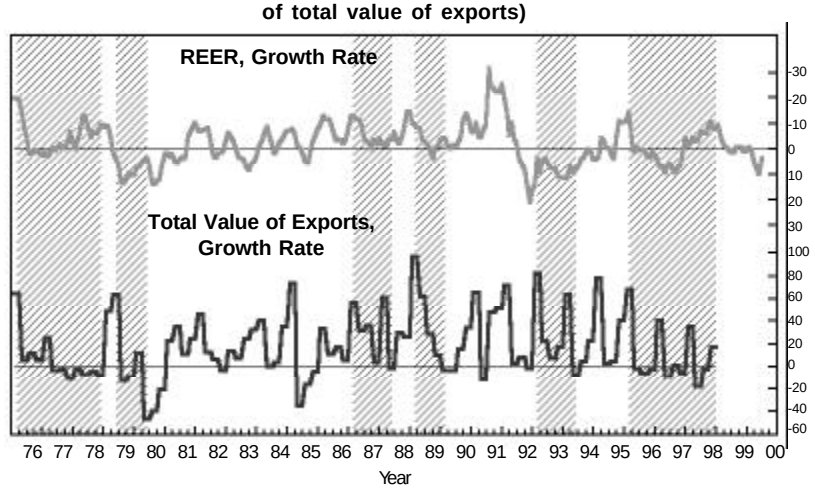

Figure 7

Lead Profile : Level of Leading Index of Exports vs. Quantum Index of Exports

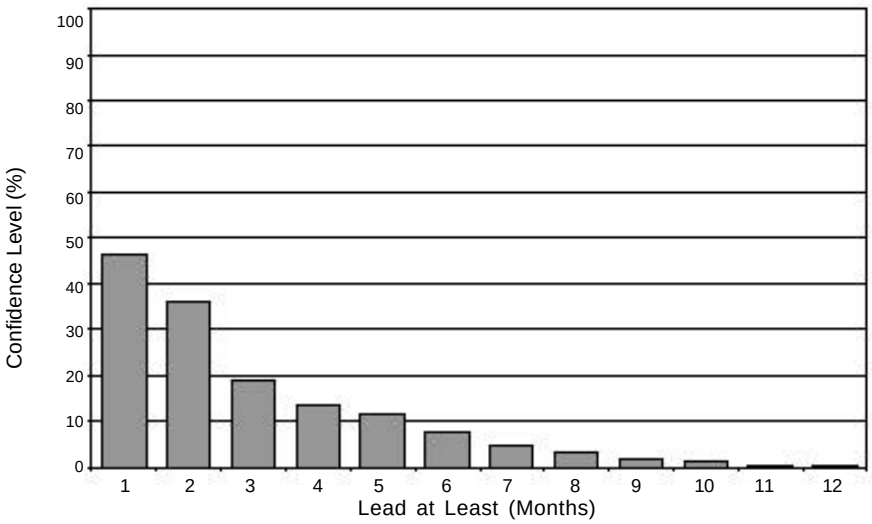

Figure 8

Lead Profile : Growth Rate of Leading Index of Exports vs. Growth Rate of Quantum Index of Exports

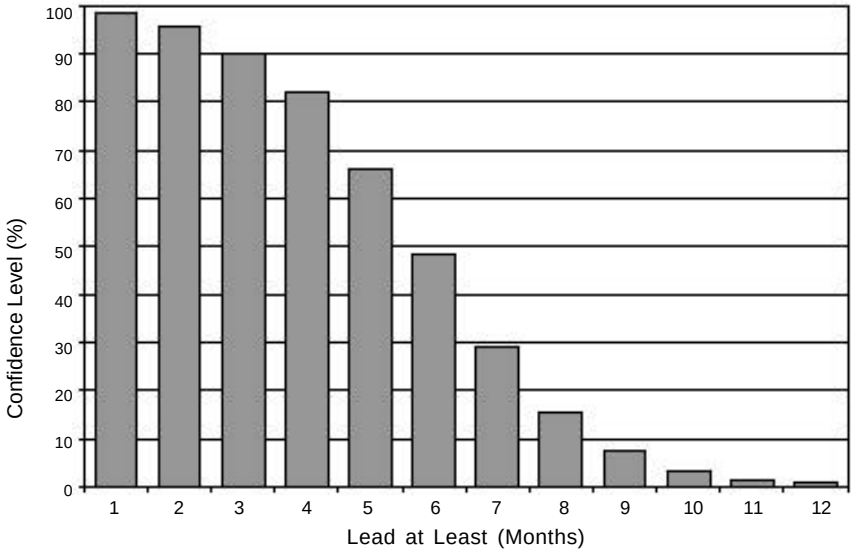

Figure 9

Lead Profile : Level of Leading Index of Exports vs. Level of Unit Value Index of Exports

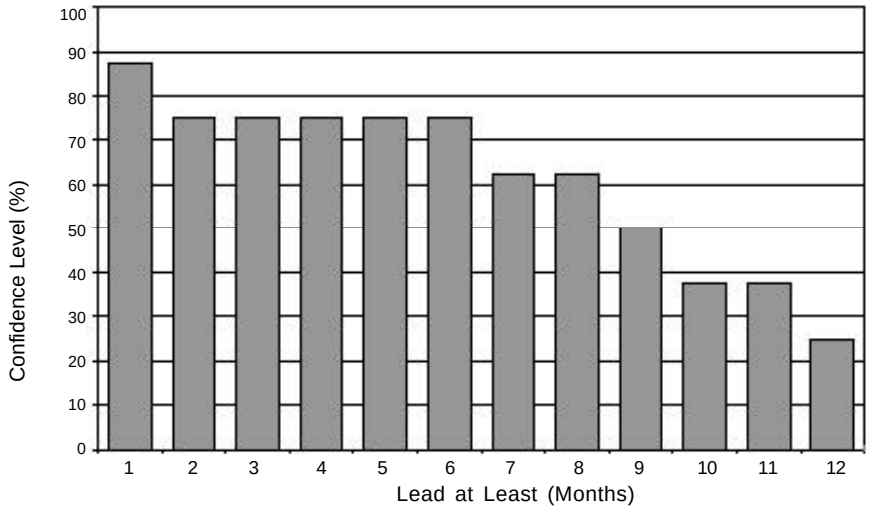

Figure 10

Lead Profile : Growth Rate of Leading Index of Exports vs. Growth Rate of Unit Value Index of Exports

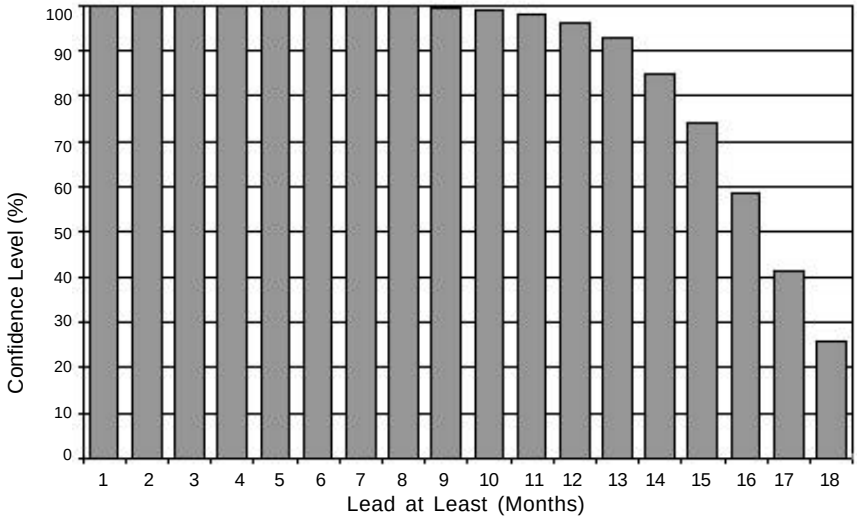

Figure 11

Lead Profile : Level of Leading Index of Exports vs. Level of Total Value of Exports

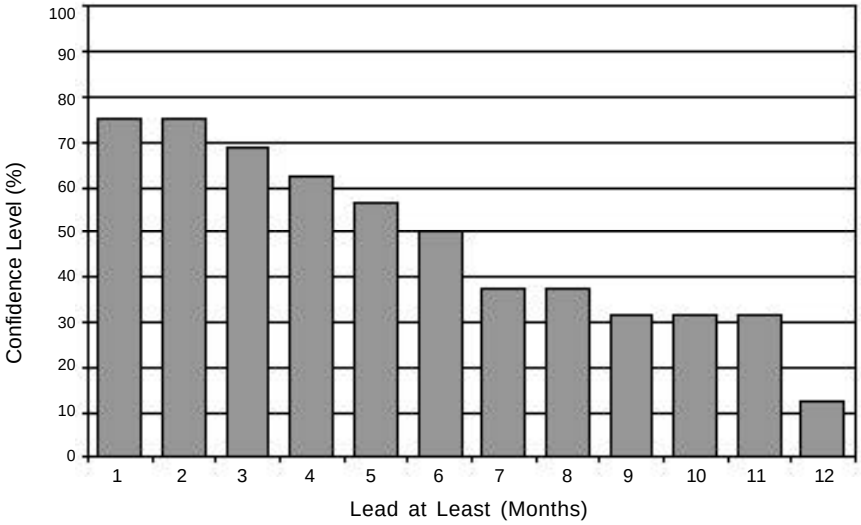

Figure 12

Lead Profile : Growth Rate of Leading Index of Exports vs. Growth Rate of Total Value of Exports