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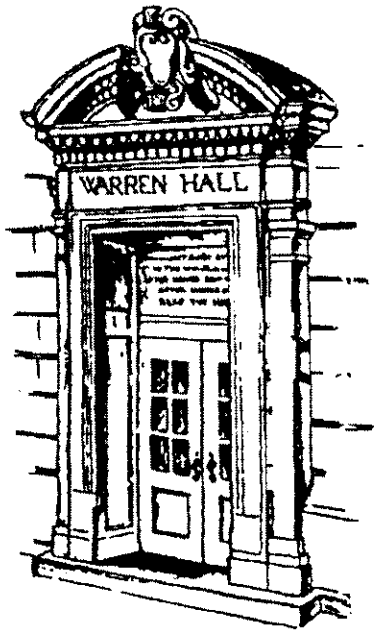

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Forecasting Industrial Sales in Bulgaria: A Leading Indicator Approach

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Forecasting Industrial Sales in Bulgaria:
A Leading Indicator Approach

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Abstract

This paper presents 3 month and 6 month composite leading indicators for Bulgarian industrial sales. The indicators are able to do a good job of tracking Bulgarian industrial sales, even given the relatively short period of time available in the data. Both the three and six month composite indicators were able to track both trends and turning points in the data. A diffusion index was also constructed but this was less successful in predicting turning points, though there is hope that in the future longer data sets will permit greater precision in this, as well as in the composite indicators.

Introduction

This paper presents composite leading indicators for the Bulgarian industrial sector. These indicators are based on a variety of readily available survey data and other economic information which are used to construct both three month and six month leading indicators.

Cyclical indicators for various economic variables have been used during the past 40 years in most industrialized market economies as tools for analyzing the business cycle. These cycles, which are periodic waves of expansion and contraction in general economic activity, characterize virtually all economies, even those during the precapitalist era (examples can be found as far back as the Roman Empire). While these expansions and contractions in the economy are of varying length and amplitude, there are regularities in their structure which make it possible to anticipate them some time ahead. This is due to the fact that economic activities, particularly production, take place over time in a sequential manner, and the level of activity at early stages of the production process is correlated with levels of activities at later stages in the future.

Accordingly, we can define various indicators of economic activities based on their relationship with the business cycle: those that exhibit cycles which foreshadow the general trends in overall activities are called leading indicators, while those that are contemporaneous with the overall trends are called coincident and those that tend to change direction after the coincident series are called lagging indicators. While all of these series are useful for analyzing the structure and timing of business cycles, it is the leading indicators which typically are the most interesting to policymakers and the general public since they allow a measure of anticipation of changes in the economic environment which can allow both business and government to adjust their activities in a timely way.

Business cycle indicator research had its genesis at the U.S. National Bureau of Economic Research in the 1950's and has been extended to a large number of countries in the world. Since the differing structure of individual economies implies that different variables may be useful as indicators of business activity, the actual composition of leading indicators varies to some extent from country to country. However, there are several characteristics which are important for any variable which is to be used as a business cycle indicator (See the periodical Business Cycle Indicators published by The Conference Board or Zarnowitz 1992 for a full discussion):

- Conformity - The indicator must track the business cycle well

- Consistency - The indicator must have a regular relationship with the business cycle, having a consistent correlation at a given lead or lag time.

- Economic Significance - There must be an economic logic underlying the timng of the indicator so that there is a high degree of confidence that the relationship is one that will hold in the future and is not simply a spurious statistical artifact.

- Statistical Adequacy - The data must be collected and processed reliably and be available without long delays so that it can be usefully analyzed before the business cycle has advanced to a stage which renders it irrelevant.

- Smoothness - The variables selected for indicators must be sufficiently smooth in terms of month-to-month movements that they are relatively reliable - excessive volatility or erratic movements obscure the underlying trends which we are trying to analyze.

In most cases, any single indicator series may prove inadequate on some of the above criteria. For this reason, much attention has been focused on the construction of composite indicators which combine the information in several underlying indicator

series to produce a single measure which is more reliable in terms of the above characteristics than any single series can be. Typically, individual series which, eg., lead the overall measure of activity which is to be predicted (usually GDP or aggregate industrial production), will be standardized by converting them into individual indices and weighted to form a composite index. Such an indicator can be considered as evidence of the strength of business cycle tendencies, since even if one or a few series exhibit only moderate movement, strong movements in others can influence the composite measure.

Another measure which makes use of several underlying indicator series is a diffusion index. A diffusion index is a measure of the extent to which a set of indicators are moving in the same direction and is constructed by measuring the percentage of the individual indicator series that are rising or falling. That is to say, if all candidate indicator series are rising then a diffusion index based on them will reach a maximum value, pointing to an increase in the reference series of interest. Intermediate values will measure the extent to which the series present a predominantly positive or negative picture, or somewhere in between. Thus, a diffusion index serves as a measure of the broadness of a business cycle tendency rather than its strength, as is the case with a composite indicator such as that described above.

While the use of cyclical indicators for the US and other OECD countries is well established, it is only since the opening of their economies in the 1990's that Eastern European countries have begun to investigate their use. (See for example Klein & Moore 1991, Nilson 1991, OECD 1997a, 1997b). While all of the transition economies have done at least preliminary work leading to the construction of cyclical indicators, Poland and Hungary in particular have developed composite indicators along the lines laid down by the OECD (See Matkowski 1997, and OECD 1997c). Both of these countries use industrial production as a reference series as is the case in other OECD countries.

Reference Series

Two variables were considered as reference series for Bulgaria. The most common reference series in countries which have a fully developed system of leading indicators is GDP, as it is this variable which is the broadest measure of economic growth and the business cycle. In Bulgaria this variable is available on a quarterly basis which limits the number of data points for which it is available to a very small number.

Another series often used as a proxy for GDP is industrial production. This is the standard reference series used for the OECD system of leading indicators and is also the series chosen as the basis for a leading indicator series in Poland and Hungary. In Bulgaria industrial production has the advantage of being available on a monthly basis, which in spite of the relatively short series available allows far greater precision in calculation of correlations than does quarterly GDP.

However, it is important to note that in Bulgaria industrial sales (the nearest concept to industrial production that is available) cannot be considered to be a proxy for GDP. Indeed, the two variables have at times moved in different directions in recent years as other sectors of the economy have at times outweighed industrial sales in determining the growth or shrinkage of overall GDP. Nevertheless, industrial sales are themselves a variable of interest, and merit construction of an index of indicators even if it cannot be considered to be a reliable proxy for GDP.

The data used are from the Spring of 1997 through the Summer of 2000. The main reason for such a truncated sample is the fact that the economy has undergone drastic restructuring and crisis through the early and mid-1990's, making it possible to use only those data generated after the major economic crisis in late 1996 and the first quarter of 1997. In addition, there are questions as to the quality of the GDP data that has

been generated, though this remains a topic of current and ongoing research. Accordingly, there is only a limited amount of statistical work which can be done on the basis of this series. Nevertheless, a set of simple correlations between indicator series and GDP can be calculated and both a composite indicator and a diffusion index calculated on those series which show a positive correlation with GDP.

Ultimately, given a long enough data series, the goal is to construct a composite indicator based on a linear combination of candidate series with weights optimized to most accurately predict the reference series of interest. Using regression coefficients is one method for obtaining an optimal linear combination. Lacking enough data to perform an optimization, a reasonable fallback position is to give the series an equal weight which can be achieved by ranking them by their correlation with the reference series at the lead time of interest (3 and 6 months in this case). Those which are most correlated can then be weighted by their correlation coefficients for inclusion in a composite index.

One implication of the shortness of the data series available for analysis is that it is not possible to evaluate the leading indicators on the basis of their ability to predict cyclical turning points. This is a direct result of the fact that the current data series contains no more than one of each, making it impossible to reach any kind of statistical basis for evaluation of ability to predict them. Nevertheless, it remains possible to evaluate indicators on the basis of their ability to predict the direction and rate of growth of the reference series.

Candidate data series for composite leading indicator

A variety of data sources are available for evaluation of their ability to predict movements in the reference series described above. They can be divided into elements of

the National Statistics Institute's Business Tendency Survey, quantitative economic data available on a monthly or quarterly basis, information from the NSI's national material balances, (available on a quarterly basis), and data series from outside of Bulgaria itself.

Business Tendency Survey Indicators

The business tendency survey is conducted monthly by the NSI and its constituent elements are shown in Table 1. All of these series were tested for their ability to predict the reference series. Those which showed a strong ability to predict them at leads of 3 and 6 months are underlined in the table. Included in this data set are two composite indicators which are computed by the NSI and which were confirmed as having good explanatory power for industrial sales. However, it was also apparent from preliminary analysis that the components of these two indexes, while good predictors, are not the only series with a good ability to predict at relatively long leads. In particular, several of the other data series are good candidates for a more general index.

Quantitative Data Series

Table 2 shows a variety of quantitative data series available from Bulgarian and other sources. Monetary, exchange rate, price and foreign trade information is available on a monthly basis, as are foreign derived data series and so can be used to predict the monthly reference series of industrial sales and prices. The foreign data series are of particular importance in the Bulgarian case, given the large share of Bulgaria's exports which are directed toward Italy and Germany, and the fact that the currency board arrangement currently in force ties Bulgaria's currency to the DM.

The foreign data are readily available over the internet and so can be reliably included in monthly calculations for the Bulgarian economy. The German data is available from the monthly reports of the Bundesbank while composite leading indicators

for Germany and Italy are available from the OECD. Preliminary tests on these indicators showed a correlation with Bulgarian industrial production that was too low for inclusion in the present version of the indicator (in the range of 35-45%). However, it is likely that this result is at least partly due to the fact that the data cover only the 1997-2000 period and that the volatility of the Bulgarian economy over this time was largely due to internal factors. Over the long run the fact that Italy and Germany are the destination of the bulk of Bulgaria's exports makes it likely that leading indicators from these countries will exhibit a closer correlation with Bulgarian data than they have in the past. Accordingly, these data merit reconsideration for inclusion in a Bulgarian indicator at some point in the future.

National material balances are calculated quarterly and contain information on production, import and use of materials at a very early stage of the production process. Specified in physical units, these data points can be obtained from the NSI early enough to be used to construct an index for predicting GDP one quarter in advance but at present are not timely enough for inclusion in a monthly indicator of industrial production.

Construction of the Composite Index

Each candidate series was considered on the basis of its correlation with each of the reference series at a 3 and a 6 month lead. They were then ranked according to their correlation and those which showed a correlation greater than 0.5 (0.48 for the 6 month indicator) were further tested to see if any were perfectly or near perfectly correlated with others, thus duplicating the information contained (This was considered to be a potential problem due to the fact that many of the indicators derive from a business tendency survey in which it is possible for answers to certain sets of questions to be highly correlated.) These results indicated that the three series related to order books, B31, B32 and B33 were highly correlated and therefore only B31 was included in further

analysis. Two other series, S62 and S63 (Insufficient foreign demand and Competitive imports), also showed a high correlation, but these were regarded as measuring independent phenomena and so were included on the presumption that the high correlations seen in past data may well not continue in the future. The correlation matrix of the series included in the composite indicator is shown in Table 3.

Each of the series were then standardized by subtracting each observation from the mean and dividing by its standard deviation over the period for which data were available. (April 1997 through April 2000) Weights were then assigned based on the correlation coefficients, with each weight equal to the correlation coefficient for that index divided by the sum of the correlation coefficients for the indexes included in the composite indicators. If the volatility of several indexes (e.g. leading, lagging and coincident) is to be equalized, a further transformation can imposed by using the standard deviations of the resultant composite indicators to equalize their volatility.

It should be noted that this procedure permits the reconfiguration of the index on a periodic basis on the basis of recalculated correlations of the indicator series with the reference series. (See for example, Seitz (97) for a study using this procedure for Germany) This is particularly important in the Bulgarian case given the liklihood that as further observations are added to the currently rather short data series, relationships between the various data series may change.

Figures 1-4 show the performance of the 3 and 6 month indicators for industrial sales. The indicator series has been displaced by 3 and 6 months respectively in order to highlight the extent to which they accurately track the future movements of the reference series. As can be seen, the fit is not as good in the early period after the stabilization of 1997, but is quite tight over the past year. In fact, the indicator does a quite good job of predicting the turning point in industrial sales that occurred during the second half of 1999.

The indicator was tested for its ability to predict the direction of industrial sales by looking at its ability to correctly forecast the sign of the change in industrial sales smoothed by using a three month moving average. This experiment showed that the indicator was able to correctly predict future sales only in about 60% of the 33 data points which could be considered. This result confirms the general practice in most OECD economies of accepting the signals given by movements of the indicators only if they are continued and sustained for a three month period. The erratic nature of month to month movements, even in economies with well developed indicator systems such as the U.S., make it difficult to interpret these movements with a high degree of confidence. Neverthless, it can be seen in the figures above that the indicators do a good job of tracking movements in industrial sales, anticipating both the peak at the beginning of 1998 and the trough in mid 1999.

In addition, the overall ability of the 3 and 6 month indicators to accurately track movements in the reference series is shown not only by the figures presented above but by the high correlations between the composite indices and the reference series. These correlations for the three and six month leading indicators were 0.87 and 0.84 respectively.

Construction of a Diffusion Index

A diffusion index was constructed based on the same underlying indicator series as the composite indicator above. Intended as a measure of the breadth rather than the strength of cyclical movements, this index measures the percentage of the component indices which are rising at any given point in time. All are equally weighted and a value of one is assigned to those indices which have risen over the past three months while a zero is assigned to those which have fallen or remained unchanged.

The resulting index is shown in Figure 5 where it can be seen that the index does a fairly good job of indicating the major turn in industrial production in mid-1999 though its performance is somewhat erratic thereafter. One possible explanation could be a relatively narrow base for growth over the past two years. It is hoped that the addition of new data points, together with experimentation with alternative formulation of indices can improve performance in the future.

Conclusions

The indicators presented in this paper are clearly able to do a good job of tracking Bulgarian industrial sales even given the relatively short period of time available in the data. Both the three and six month composite indicators were able to track both trends and turning points in the data. The diffusion index was less successful in predicting turning points, though there is hope that in the future longer data sets will permit greater precision in this, as well as in the composite indicators.

Directions for future research include a reconsideration of component series for composite indicators and diffusion indices as more data become available. In particular, as Bulgaria moves further and further from its crisis in 1997 it becomes increasingly likely that the Bulgarian economy will move more in tandem with the rest of Europe. This is particularly true of Italy and Germany, the destinations of the bulk of Bulgaria's exports.

References

Klein, P. and G. H. Moore, "Monitoring Economic Activity in Newly Privatized Economies: Statistical Targets for Eastern Europe", pp. 313-332, Business Cycle Analysis by Means of Economic Surveys, Part II, Oppenlander and Poser, Eds. Papers presented at the 20th CIRET Conference, Budapest 1991.

Lahiri, S. and G. Moore, eds. Leading Economic Indicators - New Approaches and Forecasting Records, Cambridge University Press, 1991.

Matkowski, Zbigniew "Business Cycles in Poland" Chapter 23 in Social and Structural Change - Consequences for Business Cycle Surveys, Oppenlander and Poser Eds, Selected papers presented at the 23rd Ciret Conference, Helsinki, 1997.

Nilsson, R. "OECD Leading Indicators: Applicability to Central and Eastern European Countries" pp. 85-112 in Business Cycle Analysis by Means of Economic Surveys, Part II, Oppenlander and Poser, Eds. Papers presented at the 20th CIRET Conference, Budapest 1991.

OECD, Cyclical Indicators and Business Tendency Surveys, OECD Working Paper No. 38, Paris 1997a.

OECD, Business Tendency Surveys in Transition Economies - Methodological Review and Recommendations for Harmonization, OECD Working Paper No. 39, Paris 1997b.

OECD, Cyclical Indicators in Poland and Hungary, OECD Working Paper No. 72, Paris 1997c.

Seitz, Franz, "An Index of Leading Indicators on Inflationary Trends and the Business Cycle", Chapter 16 in Social and Structural Change - Consequences for Business Cycle Surveys, Oppenlander and Poser Eds, Selected papers presented at the 23rd Ciret Conference, Helsinki, 1997.

Zarnowitz, Victor, Business Cycles - Theory, History, Indicators and Forecasting, University of Chicago Press, 1992.

Table 1

Indicators From the Business Tendency Survey*

Present business situation - in the country - B01

Present business situation - B02

Present production tendency - B2

Order-books level - total - B31 #

Order-books level - dometic - B32

Order-books level - export - B33

Stocks of raw materials - B4

Stocks of finished goods - B5 #

Future business situation - in the country - B71

Future business situation - B72

Future production tendency - B8

Price expectations - B91

Price increase - B92

Business climate = Geometric mean (B02, B72)

Confidence indicator = Average (B31, -B5, B72)

Insufficient domestic demand - S61

Insufficient foreign demand - S62 #

Competitive imports - S63 #

Shortage of labour - S64

Shortage of skilled labour - S65

Lack of appropriate equipment - S66

Shortage of raw materials and semi-finished goods - S67

Shortage of energy - S68

Financial problems - S69

Insolvency of the clients - S610

Unclear economic laws - S611

Uncertainty of the economic environment - S612

Others - S613

No limits - S614 #

*Series prefixed with a B are specified as (percent answering affirmatively minus percent answering negatively). Series prefixed with an S are specified as the share answering affirmatively. Those series which showed a strong correlation with the reference series at a three month lead are underlined while those which were correlated at 0.48 or higher at a six month lead are indicated with a #.

Table 2

Quantitative Indicators

Quantitative data available on a monthly basis from Bulgarian sources:

Exports in current USD #

Money supply (M1, M2, M3)

Currency Board Assets

Wages paid (total for country

Producer Price Index

Consumer Price Index

Long term interest rates on leva denominated bank loans

Short term yields from government bill auctions

Foreign data available on a monthly basis:

Exchange rate vs. US Dollar

Composite leading indicators for Germany and Italy,

German price index.

Data from national material balances available on a quarterly basis*:

Coals

Petroleum

Natural gas

Iron Ore

Wood

Coke

Fertilizers

Bricks

Cement

Pig iron

Electricity

Heat

Other quantitative data available on a quarterly or monthly basis:

Foreign Direct Investment

Expenditure on fixed assets

Railway transport

Cargo and Autotransport

Waterborne transport and Ports

Accomodation (Hotels)

Output of specific industrial products

Orders and sales by sector

Prices of real estate,

Employment, Hours worked, Wages

* National material balances are specified in physical units and indicate production, stocks, imports and use

Table 3

Correlation Matrix for Variables Included in the Composite Indicator

	BO2	B31	B5	B72	S61	S62	S63	S613	S614	export
B02	1.00	0.77	0.04	0.45	-0.04	-0.30	-0.27	-0.04	0.53	0.39
B31	0.77	1.00	-0.52	0.41	-0.52	-0.78	-0.71	-0.42	0.60	0.66
B5	0.04	-0.52	1.00	-0.13	0.79	0.84	0.82	0.61	-0.25	-0.54
B72	0.45	0.41	-0.13	1.00	-0.23	-0.25	-0.33	-0.33	0.35	0.19
S61	-0.04	-0.52	0.79	-0.23	1.00	0.75	0.74	0.62	-0.18	-0.39
S62	-0.30	-0.78	0.84	-0.25	0.75	1.00	0.89	0.60	-0.51	-0.70
S633	-0.27	-0.71	0.82	-0.33	0.74	0.89	1.00	0.72	-0.51	0.65
S613	-0.04	-0.42	0.61	-0.33	0.62	0.60	0.72	1.00	-0.53	-0.42
S614	0.53	0.60	-0.25	0.35	-0.18	-0.51	-0.51	-0.53	1.00	0.57
export	0.39	0.66	-0.54	0.19	-0.39	-0.70	-0.65	-0.42	0.57	1.00

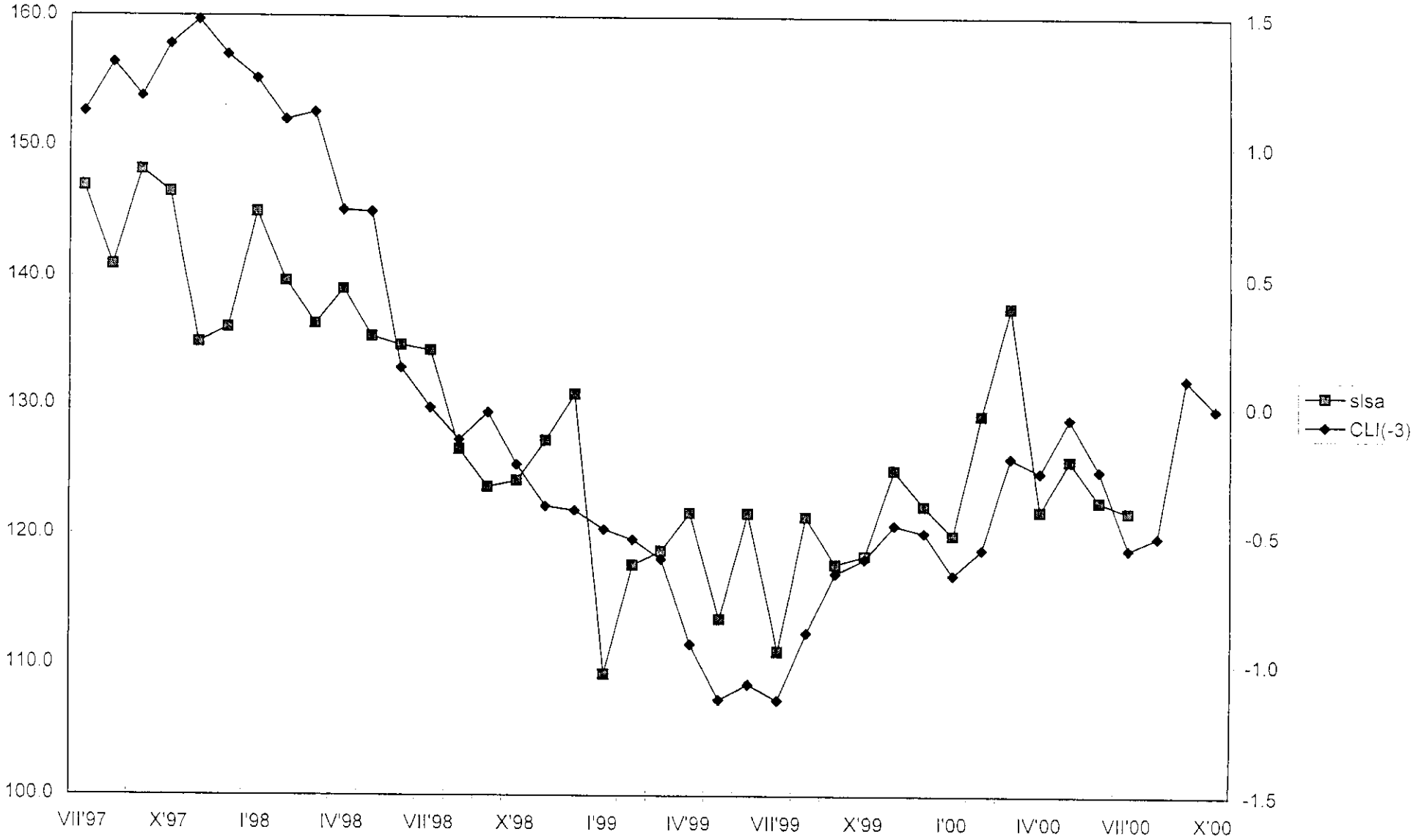

Figure 1
Three Month Composite Leading Indicator U..S. Industrial Sales

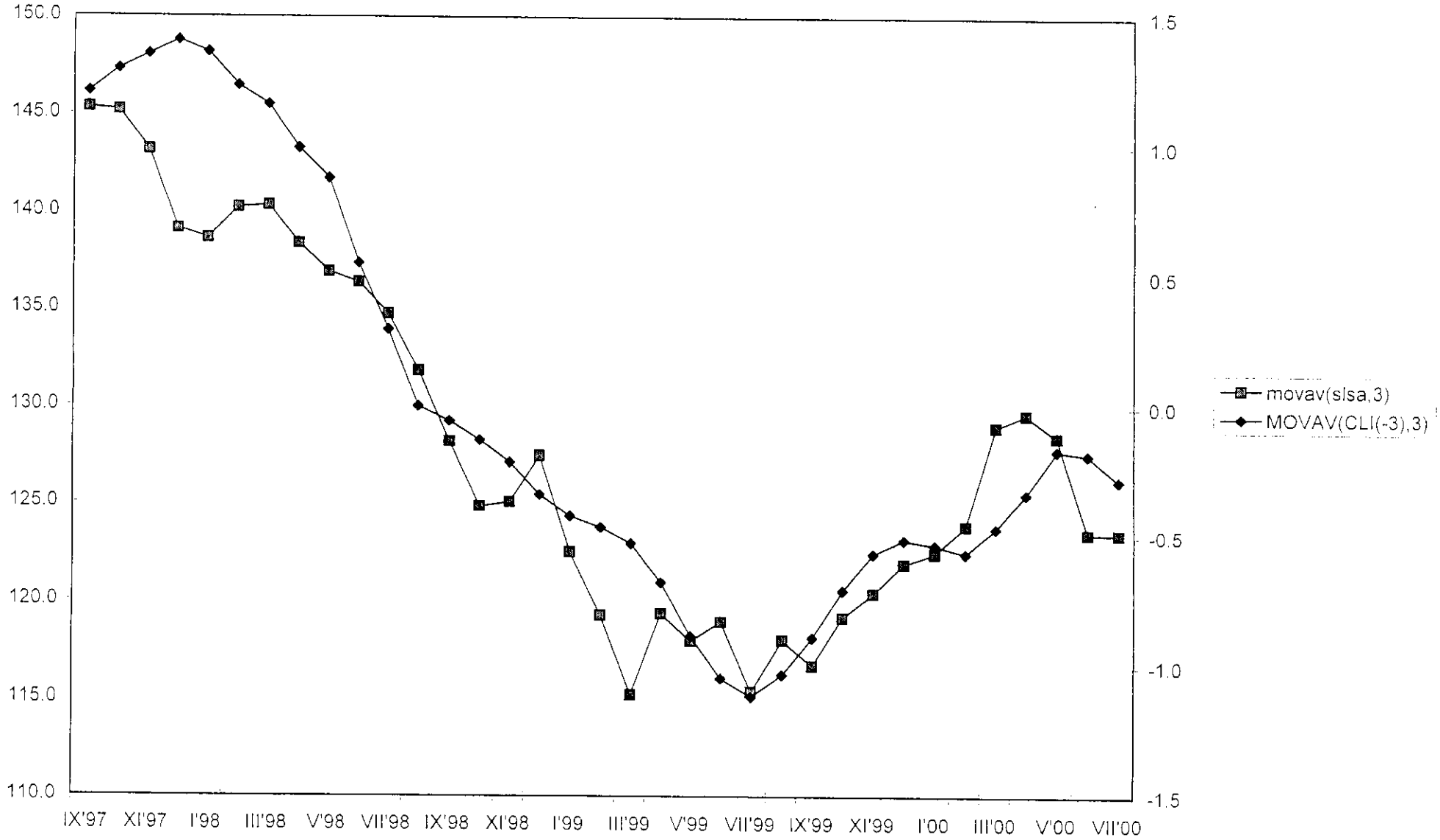

Figure 2
Three Month Leading Indicator vs. Industrial Sales
(3 month moving average)

Figure 3
Six Month Leading Indicator vs. Industrial Sales

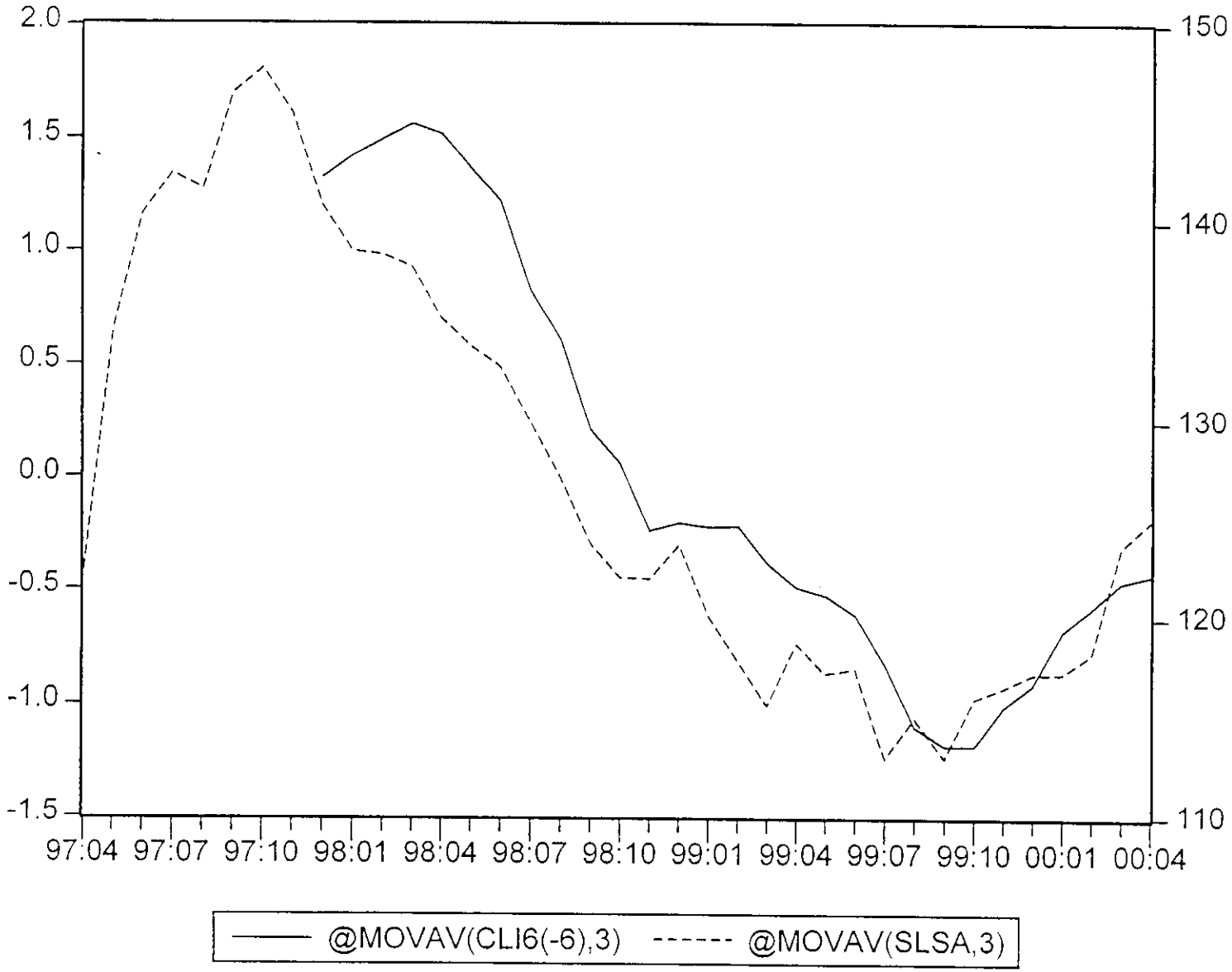

Figure 4
Six Month Leading Indicator vs. Industrial Sales
(3 month moving average)

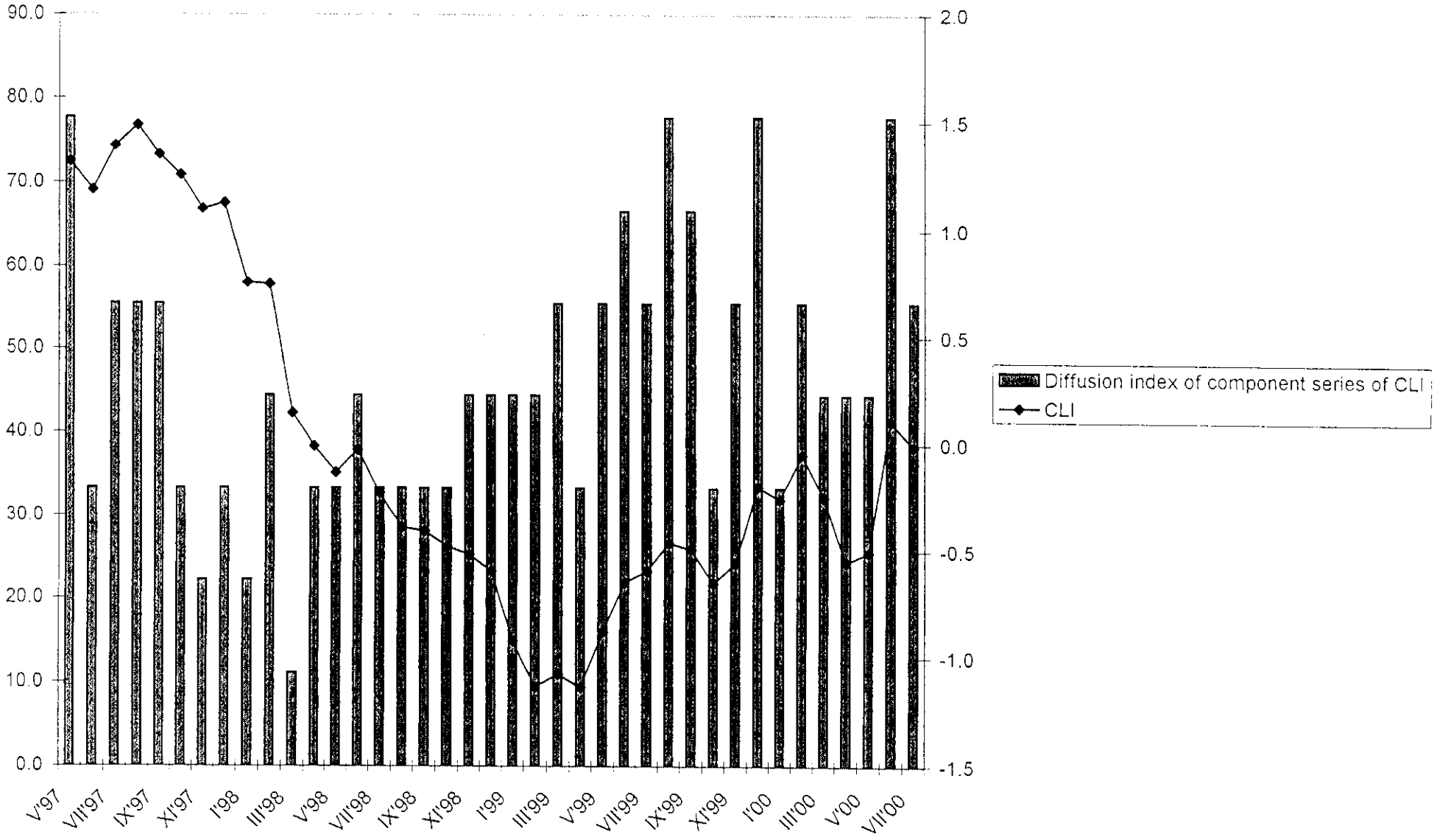

Figure 5
Diffusion Index vs. Industrial Sales

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