

COMPOSITE LEADING INDICATORS FOR POLAND AND THE CONCEPT OF THE REFERENCE CYCLE*

1. Introduction

This paper presents the preliminary results of research carried on at the Research Institute of Economic Development (RIED), Warsaw School of Economics, in the framework of the CSR project No. 1 P110 023 06 "Synthetic Indicators of Business Activity for Poland". The aim of this project is to develop an operational system of composite indicators, based on quantitative and qualitative data, which might be used for monitoring current and imminent tendencies in the aggregate economic activity. The research started two years ago and the grant awarded for this project expires at the end of this year. The RIED has applied at the governmental agencies for continuous support of its business surveying activities as well as monitoring services pertinent to the whole economy.

The paper is intended as a summary report. A detailed presentation of findings and the discussion of problems faced in this research will appear in a separate issue of the RIED's "Papers and Proceedings".

Composite indicators referred to in this paper are mainly based on available statistical data. The RIED has also developed a separate composite indicator of general economic activity based exclusively on its own survey data.

2. The Database

The database established in this project includes more than 100 individual variables representing various economic processes of direct interest for the appraisal of business conditions. Most of them are filled which official statistical data but some qualitative data from business surveys are included as well. Since all the original time series were subject to an extensive elaboration, updating and manifold transformation, the total number of time series in our database, including synthetic variables and composite indicators, has run to thousands.

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All the variables are filled with monthly data. Important indicators available on quarterly basis have been interpolated into months. As a matter of fact, the scarcity of monthly or quarterly data and many discontinuities appearing in the available time series were the most important limitations to the database. Some time series recorded in our database start in 1975, but most series begin at a later date, according to the available data.

Original data were subject to toilsome elaboration aimed at securing continuity and comparability of time series (adjusting for the change in concepts, measurement units and reference bases, deflating monetary variables etc.). Monetary and value variables have been deflated to constant prices using the relevant price indices. All the time series have been transformed into uniform indices (1992 avg. = 100) in order to facilitate direct comparison and control over the data processing.

Most statistical data have been taken from official sources (Central Statistical Office and the National Bank of Poland). Most survey data come from the RIED's own survey resources.

Time series comprising the minimum period of 5 years were subject to decomposition and an extensive analysis using X11ARIMA and OECD PAT software as well as auxiliary statistical packages. Time series of shorter duration are kept as a reserve material to be used at a later date.

3. The Reference Cycle

The actual movement of the aggregate economic activity (*reference cycle*) is reflected by a general coincident indicator GCI based on the available output data. This synthetic composite index has been developed to reconstruct the changes of the national product over years at monthly spans in the absence of GDP monthly or quarterly statistics. GCI is a weighted average of indices showing the output volumes in five major sectors of economy: 1) industry, 2) construction, 3) agriculture, 4) transport, and 5) trade. For industry and construction, activity levels are represented by the production volumes (production sold). For transport, the index is based on the physical volume of freight transports. For trade, its is the volume index of retail sales (at constant prices). For agriculture, we developed a synthetic index of market production based on the procurement volume of main agricultural products: cereal grains, slaughter animals, and cow milk (one of the GCI versions also includes procurement of potatoes).

Sectoral indicators of activity entering GCI have been transformed into volume indices based on 1992 = 100 and weighted by the yearly shares of the respective sectors in GDP (until 1989, in gross material product). The resulting

GCI index provides quite a representative picture of month-by-month changes in total domestic output. For the years 1975-1989 it covered 80-85% of GMP; for the period from 1990 till now (for which GDP data are available in accord with SNA standards) it covers 60-70% of GDP. Therefore, it may be viewed as a good approximation of the change in total national output.

*Table 1
Statistical properties of the reference series*

QCS	MCD	F-test for sasonality		Relative contribution to stationary variance			Average duration of run			Arima extrapolation (forecast)			Avg. percentage S.E. in forecast	
		stable	mov- ing	I	TC	S	I	TC	MCD	Model	R ²	χ ²	Last 3 years	Last 1 year
0.60	5	45.8 ^x	0.9	4.3	82.3	14.5	1.5	9.2	3.2	(2,1,2)(0,1,1)	0.91	63%	4.2	2.9

^xSeasonality present at the 0.1 percent level.

QCS is the monitoring and quality control statistics with critical value of 1.00 (QCS<1 is acceptable).

*Table 2
Reference cycles*

Turning points		Duration		Amplitude	
P	T	months		% change	% of trend
2/79	10/81	23		-30.3	-27.0
3/89	89			+26.8	+45.5
	10/91	31		-41.3	-39.8

In order to improve the quality of this indicator, we developed 25 versions of GCI differing more or less in coverage and in some technical details. The version used here has been coded as GCI2 and it is represented in our database by the variable 091. For the period 1975-1982 it covered industry, construction, agriculture and transport, and since 1983 it also includes retail trade.

In order to identify the cyclical movement of the economy over the last two decades or so, alternative GCI time series have been decomposed into four components of dynamics: (a) seasonal fluctuation, (b) irregular random movements, (c) cyclical change, (d) trend. The split into (a), (b) and (c) + (d) was

made with help of X11ARIMA program, and the division between (c) and (d) with the OECD PAT procedure.

Statistical properties of our GCI series used here and the quality of the estimated GCI-ARIMA model (as shown in table 1) are good enough (QCS = 0.60 is much lower than the critical value of 1.00 and squared R = 0.91) to use it both in historical analysis and for 1-year autoregressive forecasts.

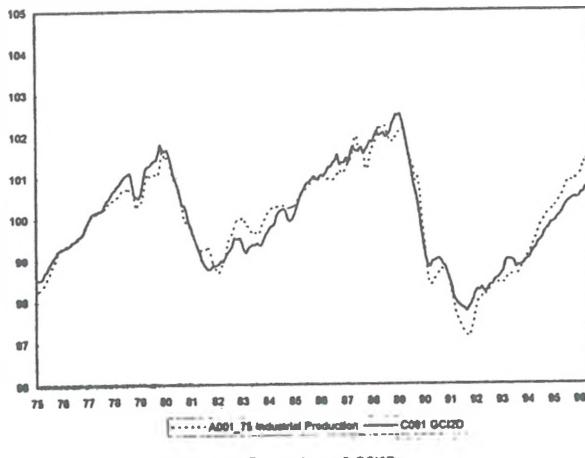
These procedures allowed us to reconstruct cyclical development of the Polish economy from 1975 till now. All our GCI's do reveal two well pronounced business cycles which had already been present at times of the centrally planned economic system, and which grew in intensity with the transformation into an open market economy. For the GCI version used here the chronology and the amplitudes of those cycles are presented in table 2. A detailed analysis of the reference cycles has been presented in a separate publication.²⁾

4. Composite Leading Indicator

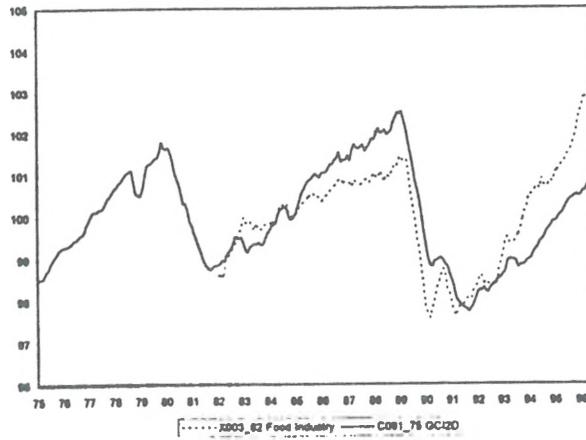
In search for leading and coincident indicators which might be of use in monitoring the change in current business activity throughout the economy, we analyzed scrupulously, with help of X11ARIMA and OECD PAT programs, all the individual time series recorded in our database, except for very short series kept as a reserve. Most series were analyzed repeatedly, using updated figures and testing alternative procedures with changing input parameters. This analysis allowed us to discriminate a set of circa 50 indicators with well pronounced cyclical patterns and a regular record of seasonal movement.

Further elimination of time series was based on the MCD criterion ($MCD < 6$) and the selection of leading indicators relied on the comparison of the deseasonalized, MCD-smoothed and detrended time series with the reference cycle. The main criteria applied here were cross-correlation coefficients at various lags, the conformity of the cyclical pattern (the number of missing or extra cycles) and the behaviour of the indicator around the reference turning points. As the result, 15 single indicators have been selected to be used in the composite leading index. This includes seven sectoral indicators of output, two indicators of the labour market, one indicator of investment, three variables of the monetary market and two sensitive indicators from the RIED survey data. Table 3 shows the full list of indicators entering two alternative CLI formulas, together with their QCS and MCD characteristics and the results of cross-correlation against the reference cycle. Table 4 shows the performance of our leading indicators around the reference cycle turning points.

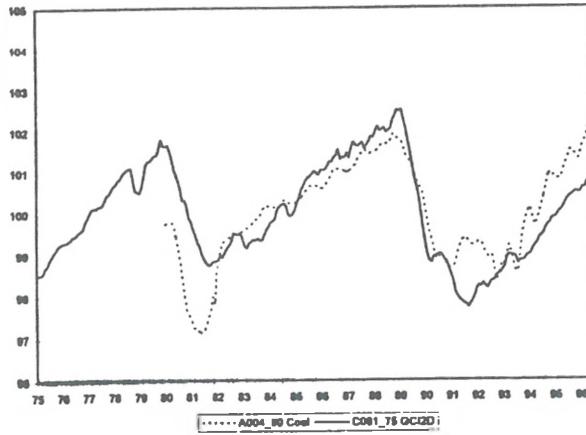
Industrial Production & GC12D



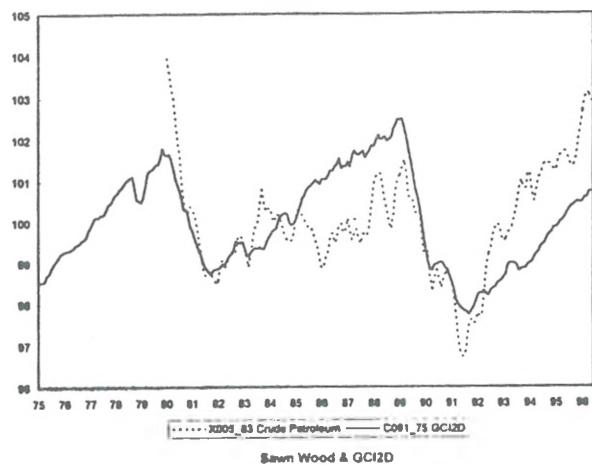
Food Industry & GC12D



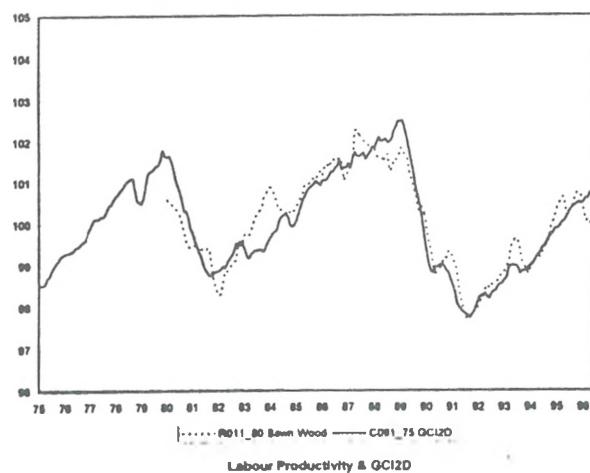
Coal & GC12D



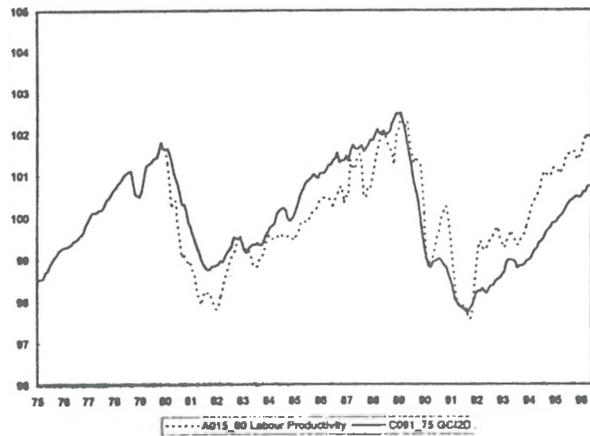
Crude Petroleum & GCI2D



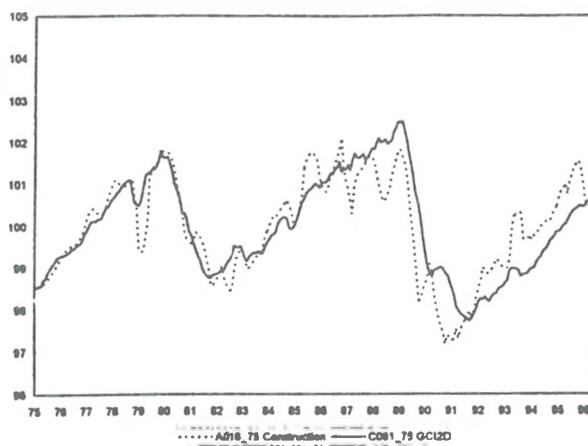
Sawn Wood & GCI2D



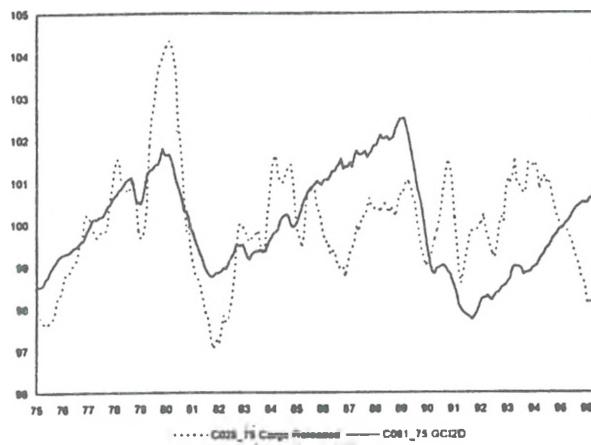
Labour Productivity & GCI2D



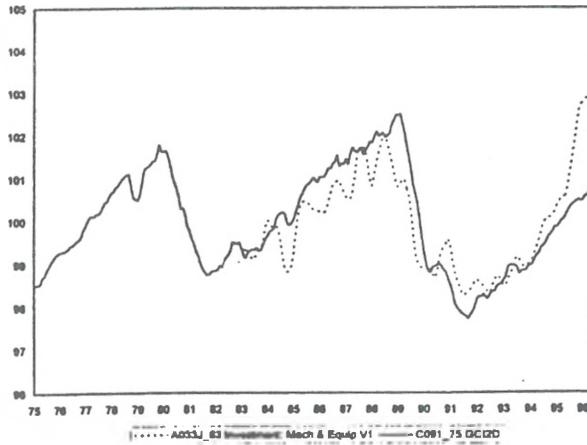
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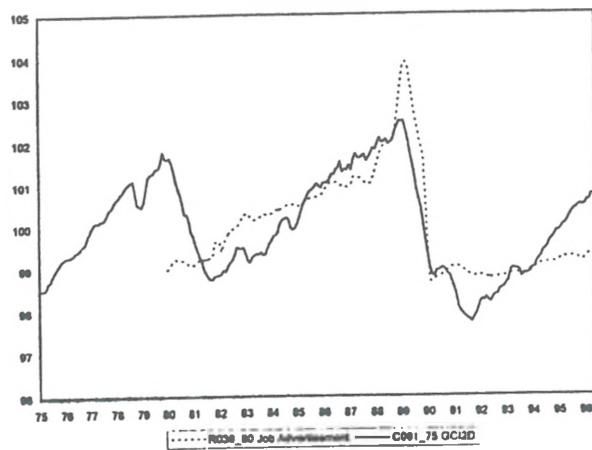
Cargo Reloaded & GC12D



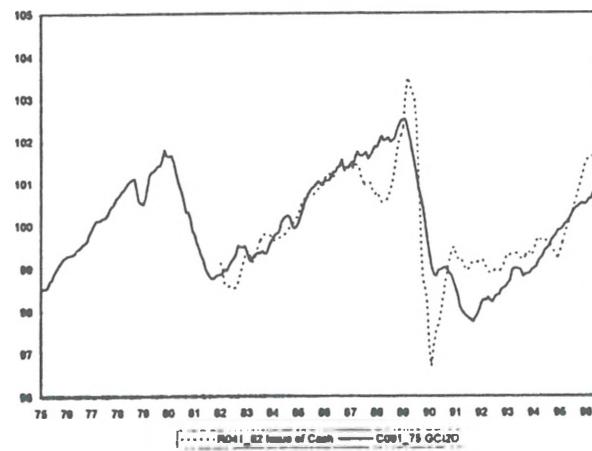
Investment: Mech & Equip V1 & GC12D



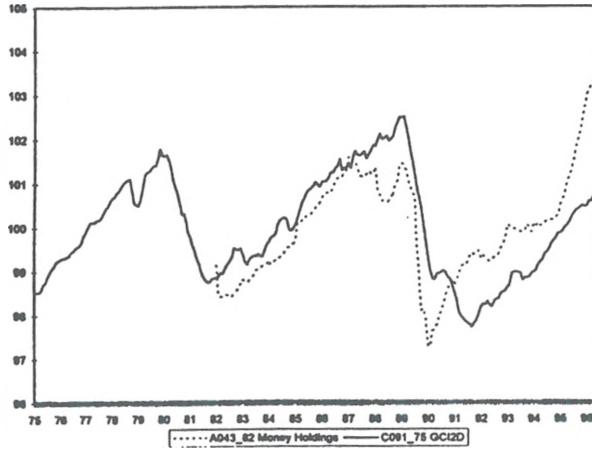
Job Advertisement & GC12D



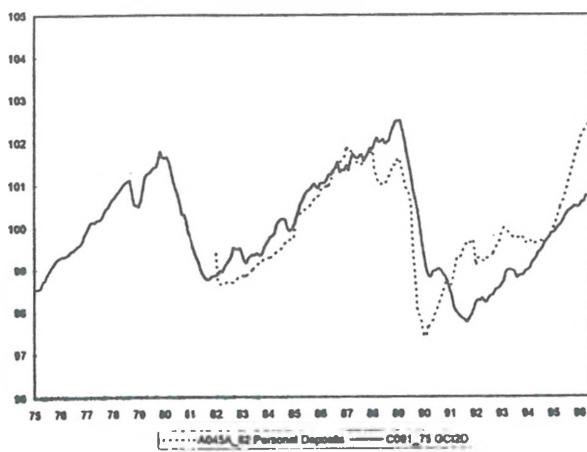
Issue of Cash & GC12D



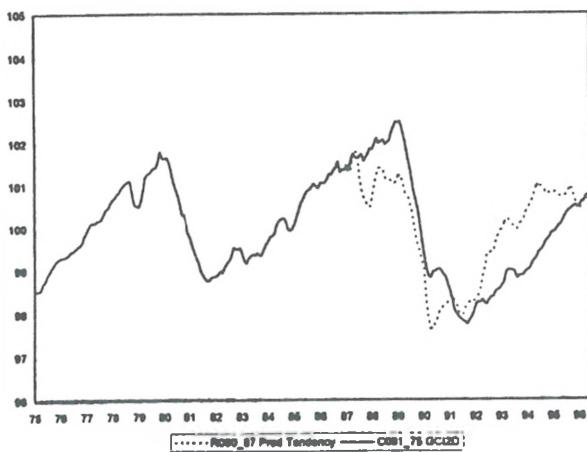
Money Holdings & GC12D



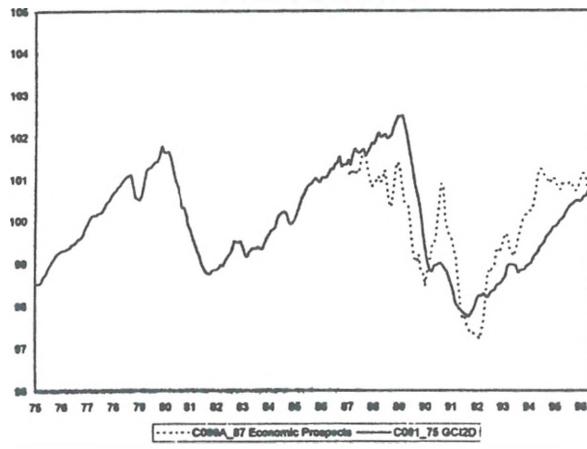
Personal Deposits & GC120



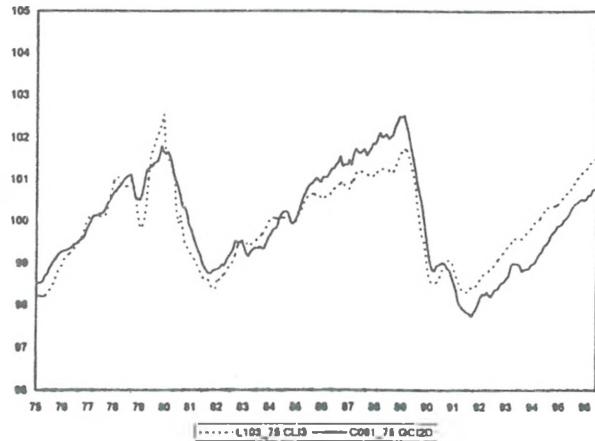
Prod Tendency & GC120



Economic Prospects & GC120



POLAND: CL13 & GCI20



POLAND: CL14 & GCI20

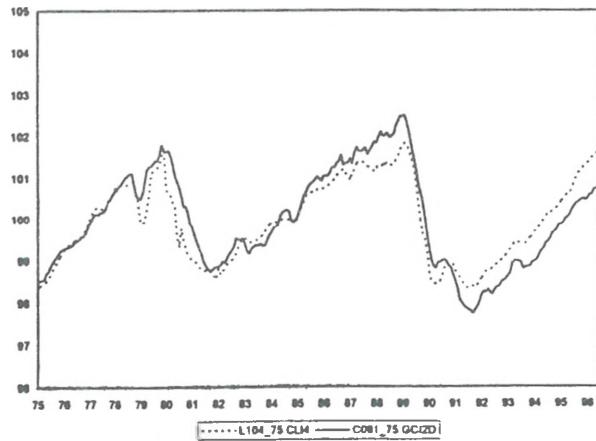


Table 3

Performance characteristics of the selected leading indicators

Code	Indicator	Start date	QCS	MCD	Cross - correlation against reference series			
					the whole period		since 1983	
	Selected Leading Indicators				lead (-)	R	lead (-)	R
A001	Industrial Production	01.1975	0.79	5	0	0.966	0	1.000
X003	Food Industry	01.1982	0.69	5	-4	0.817	-3	0.830
A004	Prod Coal	01.1980	1.21	8	-4	0.790	0	0.968
X005	Crude Petroleum Processing	01.1980	1.69	12	-1	0.563	-2	0.518
R011	Prod Sawn Wood	01.1980	0.69	5	-3	0.900	-1	1.000
A015	Labour Productivity	01.1980	0.80	3	-1	0.804	0	0.866
A016	Construction	01.1975	0.84	5	-3	0.844	-6	0.956
C025	Cargo Reloaded	01.1975	0.91	5	-1	0.386	+	ns
A033J	Investment: Mach & Equip	01.1983	0.70	6	-2	0.864	-2	0.864
R039	Job Advertisements	01.1980	0.61	3	0	0.820	-2	0.955
R041	Issue of Cash	01.1982	0.73	2	-1	0.881	-2	0.891
A043	Money Holdings of Households	01.1982	0.91	1	-3	0.667	-3	0.674
A045A	Personal Saving Deposits	01.1982	1.10	1	-4	0.809	-4	0.827
R060	Production Tendency (Industry)	01.1987	0.64	1	-6	0.976	-6	0.976
C069A	Economic Prospects	01.1987	1.39	3	-4	0.919	-4	0.919
	Composite Leading Indicators							
L103	CLI3 (all 15 series)	01.1975	1.03	1	-2	0.897	-2	1.000
L104	CL4 (13 series: all except X005 and C025)	01.1975	1.07	1	-2	0.911	-2	1.000
	Reference Series							
C091	GCI2D	01.1975	0.60	5	x	x	x	x

Since our major aim was to develop a CLI formula applicable for monitoring the current level of business activity rather than to attempt at true short-range forecasting, we focused first of all on shorter leading indicators and, in fact, we also added two coincident indicators well correlated with the cyclical component of the reference cycle. Longer leading indicators were not included in the CLI

versions presented here as to avoid possible interference of opposite cyclical phases. They shall be used to form a separate "longer" CLI.²⁾

Table 4

Historical performance of leading indicators at reference cycle turning points

Code	Indicator	Start date	Extra or missing cycles	Leads or lags at turning points			
				P12/79	T10/81	P03/89	T10/91
A001	Industrial Production	01.1975	1x	0	+3	-11	0
X003	Food Industry	01.1982	0		na	-2	-7
A004	Prof Coal	01.1980	1x		-4	-5	-5
X005	Crude Petroleum Processing	01.1980	2x		+2	0	-4
R011	Prod Sawn Wood	01.1980	0		+2	-17	-1
A015	Labour Productivity	01.1980	1x		+3	-1	+2
A016	Construction	01.1975	2x	+1	+9	-2	-12
C025	Cargo Reloaded	01.1975	3x	+3	0	0	-6
A033J	Investment: Mach & Equip	01.1983	1x		na	-8	-3
R039	Job Advertisements	01.1980	1x		-11	-1	-17
R041	Issue of Cash	01.1982	1x		na	-1	-20
A043	Money Holdings of Households	01.1982	0		+3	-2	-9
A045A	Personal Saving Deposits	01.1982	1x		+5	-17	-19
R060	Production Tendency (Industry)	01.1987	1x		na	-11	-17
C069A	Economic Prospects	01.1987	1x		na	-13	-14
L103	CLI3 (all 15 series)	01.1975	0	0	+3	0	-3
L104	CL4 (13 series: all except X005 and C025)	01.1975	0	0	+3	-1	-3

In this paper, we present two alternative formulas of CLI, denoted CLI3 and CLI4. The first one includes all the 15 indicators listed in table 3 while the second excludes two more erratic and less correlated variables: petroleum processing and cargo reloaded. The resulting CLI's are characterized by the correlation coefficients of 0.90 and 0.91 at 2 or 3-month lead over the whole period, and even higher correlation (1.00) with the reference cycle for the period starting in 1983, covered by almost all the indicators entering the composite index. The performance of our leading indicators around the cyclical turning points is less satisfactory, but it seems to improve towards the end of the period, with the progress of economic reforms and the transformation of economic system.

The historical performance of our CLIs and their component indicators is also shown on the enclosed graphs. The graphs show the leading indicators and the reference GCI series in terms of seasonally adjusted, MCD-smoothed and detrended data, after standardization. The final presentation will include amplitude-adjusted indicators with the restored trend.

All the indicators presented here have been updated till June 1996. Since the information lag is typically 1-3 months, with 2- or 3-month lead our CLI seems to be quite a useful tool in evaluating the current level of economic activity on a quarterly or monthly basis.

The procedures used in developing our CLIs follow the OECD methodology of leading indicators, apply the same concepts and technical terms and make use of the same computer program, so they may be viewed as comparable with the OECD standards. The only major exception is that four time series entering our CLI (denoted with the letter R), for which the PAT program failed to work, were detrended by means of linear regression. At the same time, our concept of the reference series GCI is, by and large, quite original and it seems to be more applicable to the economies in transition.

5. Conclusion

Alternative concepts of GCI based on sectoral output data have been tested to find the best formula applicable as a reference monthly series for Poland's economy. The latter was used to reconstruct the business cycle chronology and amplitudes over the period from January 1975 till June 1996.

Two alternative formulas of a composite leading indicator for Poland have been presented nad confronted with the reference cycle using the OECD methods and procedures. The results seem to justify the conclusion that the RIED now is in possesion of an operational system, based on leading indicator approach, which can be further developed and improved, but which may already be used for a systematic evaluation of the tendency in the aggregate economic activity. While our CLI is deliberately confined to monitoring the current level and tendency of economic activity, the reference composite indicator GCI may well be used for extrapolative 1-year forecasts.

In its first operational use, our monitoring system correctly detected the ensuing slowdown of economic growth as early as in February 1996, or roughly half a year earlier than most other sources did. Our GDP forecast for 1996, announced in March, was 3.5%, in sharp contrast with the official target of 6.0%. In September, the official estimate for 1996 was reduced to 4.5%, a figure more comparable with our original forecast. At this moment (mid-October) we have an

extrapolative ARIMA forecast of GCI till June 1997 on a monthly basis (including seasonal factor). In the further research we shall try to improve our short-lead CLI and to develop a separate CLI based on longer lead indicators. New promising indicators will also be tested and included as soon as we collect time series of a minimum length required in this kind of research.

Bibliography

¹Z. Matkowski, *Ogólny wskaźnik koniunktury dla gospodarki polskiej* (General Indicator of Business Activity for Poland), „Ekonomista” 1996, No. 1.

²In further work, following the presentation of this paper, we developed an improved version of "short CLI" (L105) and a "long CLI" (L108), with 12 months lead, as well as an intermediate version (L109) merging the non-repeated elements of the two. See the follow-up study in this volume: Z. Matkowski, *Barometry koniunktury dla gospodarki polskiej* (Leading Indicators for the Polish Economy).