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Abstract

This paper reviews the theoretical methodology on economic indicators, and constructs an aggregate index of coincident economic indicators for Estonia. The index tracks economic activity fairly well for the sample period. The evolution of the index in the first eight months of this year suggests that the pace of economic expansion in Estonia is slowing down significantly: from a growth rate of 10.5 percent in the first eight months of 1997, to 6.0 percent in the same period of 1998.

JEL classification: E32; E37; O52

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[1]The views expressed in this paper are the authors' and do not necessarily represent those of the International Monetary Fund.

1 Introduction

One of the difficulties facing economic analysts and policy-makers in a number of countries is the absence of a timely, high-frequency, reliable indicator of aggregate economic activity. Gross Domestic Product statistics, which are considered to be the broadest indicator of economic activity, are generally of low frequency (at best quarterly) and become available with considerable lags, often of several months. In these conditions, it is almost impossible for policy-makers to identify the current phase of the business cycle in an accurate and timely fashion and, therefore, to design and implement the correct economic policies over the cycle. Lack of timely information about current economic conditions may delay the introduction of necessary measures, or lead to a policy response that falls short of (or exceeds) what is required. This handicap becomes more severe when the business cycle is near a peak or a trough, when economic policies may need to be drastically adjusted.

To address this problem, economists have been using various high-frequency series as proxies, or indicators, for the state of the business cycle. The indicator approach was originated in the 1930s by Wesley Mitchell and Arthur Burns at the US National Bureau of Economic Research, and has gained wide acceptance since then. Today, single or aggregate indicators of economic activity of various degrees of sophistication are regularly used by government agencies, research centers, and market participants.

In Estonia, GDP estimates are produced by the Statistical Office on a quarterly basis with a lag of almost two quarters.[2] The rapid acceleration of economic activity last year, when GDP growth reached 11.4 percent in real terms, and the attendant debate about "overheating" of the economy (both within Estonia and with the IMF) drove home the need for timely and reliable indicators of economic activity, especially at times of aggregate demand pressures and growing external imbalances. As there are no official indicators of the state of the business cycle, in practice the Estonian authorities use a variety of high-frequent indicators to gauge the situation in the market, such as inflation, industrial production, or various monetary aggregates. However, there is no information on how well and how consistently these indicators track overall economic conditions.

After a brief discussion of the different approaches for constructing business cycle indicators and their shortcomings in Section 2, we construct a monthly index of coincident indicators for overall economic activity in Estonia, and present our methodology and main results in Section 3. Our index appears to track real GDP fairly well during the period 1995-97 and, since it relies on monthly series that become available with one month lag, it is a significant improvement over the current situation in terms of timeliness.

2 A primer on business cycle indicators[3]

The mainstream approach to constructing business cycle indicators has changed little since the 1930s. The basic idea underlying this approach is that the business cycle "consist[s] of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals, which merge into the expansion phase of the next cycle" (Burns & Mitchell 1946). It follows that the general level of economic activity, which is an unobservable variable, can be traced in a large number of observable economic indicators that move in the same expansion-and-recession cycle. These indicators fall into three categories, leading, coincident, and lagging, based on the timing of

[2] In early 1998, the Estonian Statistical Office started for the first time to publish preliminary quarterly GDP estimates with a lag of just over one quarter, in anticipation of the final estimates published with a two-quarter lag. Although these preliminary estimates are an improvement in terms of timeliness, their reliability is not yet established.

[3] This section draws mainly on Conference Board (1996 and 1998); see also the discussion in Gorton (1984). For a brief review of the literature and an example of constructing a simple index of business cycle indicators, see also IMF (1995).

their movements. The leaders tend to shift direction in advance of the business cycle, and for this reason they get the lion's share of the attention. The coincident indicators move at the same pace as aggregate economic activity, and their movements essentially define the business cycle. Finally, the lagging indicators tend to change direction after the coincident series. Although on the surface lagging indicators seem to have little practical value, dismissing them as inconsequential would ignore vital information about the business cycle process, because these indicators often signal structural changes in the economy.

The high-frequency (typically monthly) economic series that are used as business cycle indicators are chosen on the basis of a number of economic and statistical criteria. For example, the methodology used by The Conference Board in the US is based on six criteria (Conference Board 1998):[4]

- *conformity:* the series must conform well to the business cycle;
- *consistent timing:* the series must exhibit a consistent timing pattern as a leading, coincident, or lagging indicator;
- *economic significance:* the cyclical timing of the series must be economically logical;
- *statistical adequacy:* the data must be collected and processed in a reliable way;
- *smoothness:* the movements of the series over time must not be erratic; and
- *currency:* the series must become available on a reasonably prompt schedule, preferably within a month.

Series that are chosen as indicators are classified as leading, coincident, and lagging using "reference dates", i.e., turning points in the series. To surmount the shortcomings of individual series, the indicators are then usually combined into composite indices, after some further statistical manipulations, such as de-trending or seasonal adjustment, smoothing, and scaling. The success of these indices is judged on the grounds of how well they track the business cycle and, in particular, its turning points.

Clearly, the crucial steps in this methodology are the choice of the series and the choice of weights in forming the composite index. Unfortunately, there is no single accepted guide for these steps. Different researchers use different ways, and ultimately these choices are made atheoretically, in an arbitrary fashion, with a view to maximizing fit and in-sample forecasting performance. For this reason, some composite indices do not stick to the Conference Board's stringent selection criteria above, and do not include only economic variables: time trends and random-walk processes, for example, have often been shown to be good predictors of economic activity.

This inevitable degree of arbitrariness of the mainstream methodology is the departure point for a newer method, proposed by Stock & Watson (1988 and 1993). They postulate an unobservable variable called "the state of the economy", which affects other observable series, and estimate rigorously the former from the latter using a dynamic factor analysis, or single-index model. This technique purports to eliminate the arbitrary element both from the decision which variables to include in the aggregate index, as well as from the choice of weights, which are now obtained as estimates of the econometric model. It also allows a formal derivation of the statistical properties of the index, which are unknown under the mainstream methodology.

A conceptual problem faced by both methodologies is what benchmark to use for evaluating the composite index. Statistical tests, such as those conducted by Stock & Watson on their coincident index (whiteness tests of the residuals of the observable series and cointegration tests for the observable series) can check the internal coherence of the model, but cannot determine the accuracy of their index: for this, an "external" benchmark is needed. Interestingly, Stock & Watson use BEA's coincident index as a benchmark for their index. But using an existing composite index to evaluate a proposed new one

[4]The Conference Board is, since December 1995, the official source for the composite indices of leading, coincident, and lagging indicators formerly compiled by the Bureau of Economic Analysis (BEA) of the US Department of Commerce. Becman & Trapscot (1987) present the methodology used previously by the BEA. For a discussion of the methodology used by the UK Central Statistical Office for the construction of business cycle indicators see Moore (1993).

begs the question what is an appropriate benchmark for the existing index.

This problem has not been resolved in a universally accepted way. A natural candidate for a benchmark would be GDP. However, GDP is not available on a monthly basis. In addition, it has been argued that, despite its broad coverage, GDP may be a limited concept where business cycle fluctuations are concerned; in other words the concept of "economic activity" may be wider than GDP (Stock & Watson 1993). Other economic variables, notably industrial production, are also often used as benchmarks, on the grounds that they capture well the turning points in the business cycle. But since the composite indices usually include these variables, is not surprising that they tend to track these variables well.

While these conceptual questions remain open, economists continue to use single or composite indicators of the business cycle. The consensus today seems to be that the advantages of the pragmatic, mainstream approach in terms of simplicity and transparency outweigh its lack of a clear theoretical foundation. While Stock & Watson's approach is statistically more rigorous and limits the arbitrariness of the traditional method, it is more complicated and, in addition, falls down at some of the same points as the mainstream approach, notably the lack of an acceptable benchmark. For these reasons, it has not gained wide currency. In the next section, we use a hybrid of the two approaches to construct an index of coincident indicators for Estonia.

3 The construction of an index of coincident indicators (ICI) for Estonia

Our guiding principles in constructing an ICI for Estonia are (1) utilizing as much of the available statistical information as is feasible without compromising the timeliness of the index; (2) limiting to the extent possible *ad hoc* choices that cannot be explained on economic grounds; and (3) using a simple and transparent methodology, which is easy to explain and whose results can be independently confirmed. These principles also dictate our choice of a coincident, rather than leading index.

The small number of observations is the main problem hampering the construction of an index of business cycle indicators for Estonia. Although a number of candidate monthly series are at hand, they generally are statistically reliable only starting in 1994-95. In addition, to the statistical limitations, there are also economic ones: the unsettled economic conditions and rapid restructuring of the economy during the initial period of transition diminish the reliability of any index based on early observations. For these reasons, only data starting in 1995 were used in our estimations. To eliminate seasonal variation, we used year-on-year changes.[5]

The small number of available observations means that the statistically rigorous method of Stock & Watson cannot be used in this case. However, we have tried to minimize the arbitrary element in the choice of weights used in the aggregate index by following a hybrid approach: while the variables to be included in the ICI and the size of the weights assigned to each are ultimately a matter of choice, this choice is informed by a statistical analysis of the correlation between the candidate variables and our benchmark variable.

We use GDP as the benchmark variable on the grounds that (a) GDP is at least partly observable (on a quarterly basis), thus allowing direct evaluation of the ICI; and (b) even if GDP is a "narrower concept" than the business cycle, an ICI that tracks well GDP would still be very useful for policy-making. This approach, however, has a cost: in order to use GDP for evaluating the ICI, we need to use interpolation to generate a monthly GDP proxy from the quarterly series, thus diluting the information content of the time series and introducing an element of arbitrariness in the

[5]Instead of the simple rate of change $r = 100*(X_t - X_{t-1}) / X_{t-1}$, we also experimented with the so-called Asymmetric≅ rate of change formula: $r = 200*(X_t - X_{t-1}) / (X_t + X_{t-1})$. This formula has the advantage that increases or declines of the same absolute magnitude are translated into equal percentage increases or declines. For this reason, the symmetric rate of change is preferred by the producers of some composite indicators (most notably the Conference Board). However, in our case the results were not substantially different, and we have stuck with the conventional rates of change.

estimation.

We started with as wide a menu of candidate monthly series as possible, provided that they are publicly available with a lag no greater than two months. These series were:

- industrial sales (INS)
- local government revenues (LGR)
- imports (IMP)
- state budget revenues (SBR)
- wholesale trade (WST)
- retail trade (RTT)
- exports (EXP)
- money supply (M1)
- electricity consumption (ELC)
- registered unemployed (UMP)
- heat production (HPR)
- electricity production (ELP)
- fuel consumption (FLG)
- overnight stays by foreign visitors (FQN)

After de-seasonalizing, we tried to establish how well the candidate variables track our benchmark variable (GDP). At a first stage, this was done by a simple visual inspection of the correlation between each candidate variable and GDP. We discarded six variables (SBR; UMP; HPR; ELP; FLG; FQN) that were clearly uncorrelated with GDP. The state budget revenues (SBR) series turned out to have virtually no correlation with GDP because it is affected by "lumpy" payments of certain large taxes during the year (e.g., VAT), whose timing changed during the observation period. LGR, in contrast, which consists mostly of personal income tax, is relatively smooth, and correlates well with economic activity. At the second stage, we estimated a number of OLS regressions between GDP and the remaining candidate variables, both individually and group-wise, and tested for the significance of the correlation coefficients. Once again, in order to ensure as wide a group of variables as possible, we rejected only those variables whose βs were insignificant at the 90 percent confidence level, rather than the customary 95 percent level. After this second stage of selection, the set of candidate variables narrowed to four:

- industrial sales (INS)
- local government revenues (LGR)
- imports (IMP)
- money supply (M1)[6]

Charts 1-4 present the year-on-year change in these series compared with the year-on-year change of our target variable, GDP. The Table below presents the results of the OLS regression involving these four variables.

	Coefficient	*Standard Error*	*T -Stat*
Constant term	0.363773	0.039017	9.323353
Ind. Sales (INS)	0.329277	0.048983	6.722259
Imports (IMP)	0.140609	0.032919	4.271370
Local gov. rev (LGR)	0.078233	0.011068	7.068655
Money supply (M1)	0.075621	0.032728	2.310634

A number of observations are in order. First, in all regressions the constant term was consistently significant. This result is not surprising: since the variables are expressed in terms of year-on-year change, the constant term is the equivalent of a time trend, and time trends have often been found to be very accurate predictors of GDP. Its main influence on the ICI is to dampen fluctuations caused by the other components of the index: the greater its relative weight, the smaller the responsiveness of the aggregate index to fluctuations of the other variables (at the limit, a weight of one for the constant term would produce an index that would simply track a straight-line time trend).

Second, by far the most significant variable in most regressions was industrial sales (INS). In fact, an index consisting only by industrial sales and a time trend would predict actual GDP fairly well during the observation period. However, our presumption is that the sensitivity of such an index to changes in the underlying economic structure would probably be very high, and for this reason we would prefer using as much information as

[7]M1 = cash issued by Central Bank - (banks= vault cash + vault cash of loan and savings co-operatives) + demand deposits held with banks.

possible from the sample.

Third, our regression analysis indicated that some variables that we had expected to show a strong correlation with GDP (notably RTT, WST, ELC, and EXP) had in fact very small and insignificant coefficients. The probable reasons for this are different in each case. In some cases, the low predictive power of a candidate series (such as exports or retail trade and wholesale trade) may be explained by the fact that its information content is already captured by another series (industrial sales in the case of exports, since a very large part of the Estonian industrial production goes to exports; and imports in the case of retail trade and wholesale trade). The low predictive power of electricity consumption (which, in addition, turned out to have a negative coefficient in most regressions) may be explained by the proliferation of energy-saving technologies as a result of the rapid rise of electricity tariffs, which has altered the structural relationship between electricity consumption and economic activity over time.

We constructed the aggregate index using the above mentioned four variables and the constant term. We assigned weights based on the estimated coefficients of the regression, setting the weight of the constant term equal to 0.3763, slightly above the regression estimate, so that the weights of all components sum to one. The weights used for the four component series were the following:

Industrial sales (INS)	0.3293
Imports (IMP)	0.1406
Local government revenue (LGR)	0.0782
Retail trade (RTT)	0.0756

4 The results

Charts 5-7 present the results. Chart 5 shows the ICI (expressed in terms of year-on-year changes) for the period January 1995 - June 1998. Chart 6 shows the ICI (expressed as an index) compared directly to the actual quarterly GDP data (the latest quarterly national accounts are available for the first quarter of 1998). And Chart 7 shows the ICI compared with monthly “proxy” GDP data (in terms of year-on-year change). Charts 6 and 7, in particular, suggest that the ICI tends to track the turning points of GDP remarkably well.

The ICI suggests strongly that there is evidence of a slowdown in the pace of economic activity in the first half--and, especially, the third quarter--of this year. In the first half of 1998, the ICI showed a decline of economic growth to 7.5 percent from 10.1 percent in the first half of 1997.

Economic growth declined especially in the second quarter of 1998, to 5.8 percent from 11.9 percent in the second quarter of 1997. This slowdown is reflected in almost all component variables. The growth of INS, the most significant predictor of GDP, dropped from 20.5 percent year-on-year in the second quarter of 1997 to 9.7 percent in the second quarter of 1998, while the growth rates of IMP, LGR and M1 also fell. IMP slowed down from 32 percent year-on-year in the second quarter of 1997 to 15 percent in the same period of 1998; LGR from 10 percent year-on-year in the second quarter of 1997 to 8 percent in the second quarter of 1998; and M1 from 19 percent year-on-year in the second quarter of 1997 to -0.8 per cent in the second quarter of 1998.

For first two months of the third quarter, the ICI shows the continuation of the economic slowdown started in the second quarter of this year. During the first 8 months of 1998, the ICI indicates economic growth by 6 percent compared to the same period of 1997.

Looking at the monthly evolution of the data, the ICI year-on-year growth declined in April 2.7 percent, reflecting a slowdown in INS to 4.4 percent in that month, as well as negative year-on-year growth for LGR (-7 percent) and M1 (-0.1 percent). In May and June, on the other hand, the ICI accelerated somewhat (year-on-year growth rates of 7.0 percent 8.1 percent, respectively). The June figure, in particular, reflects a hike in LGR to 25.6 percent year-on-year. Given that the largest component of local government tax revenue is personal income tax receipts that are collected in May and June every year (on the basis of the previous year’s taxable income), and that 1997 was a year of exceptional incomes growth, this hike in LGR seems to be a temporary blip.

In July the ICI’s year-on-year growth slowed down to 3.3 percent, reflecting the negative year-on-year growth for LGR (-3 percent) and M1 (-10.1 percent), as well as the slowdown in INS to 7 percent. In August, the year-on -year growth rate became negative for the first time since mid-1996 at -0.2 percent. This was reflected by very small growth rate of INS at 0.7 percent and negative growth rates for IMP (-1.3 percent) and M1 (-11 percent).

Although we have focussed on the measurement, rather than the analysis of economic activity in Estonia, and the explanation of the apparent slowdown this year lies outside the scope of our paper, it would appear that there are three main causes behind this slowdown: first, the natural return of economic expansion to a more sustainable pace after the exceptionally rapid growth in 1997; second, the wealth effects of the stock market crash in late 1997; and third, the impact of the limited fiscal policy tightening in 1998, as well as the measures taken by the central bank to reduce bank credit growth and strengthen the capital base of the banking system.

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Chart 1 **INS and GPD, year-on-year change, in percent**

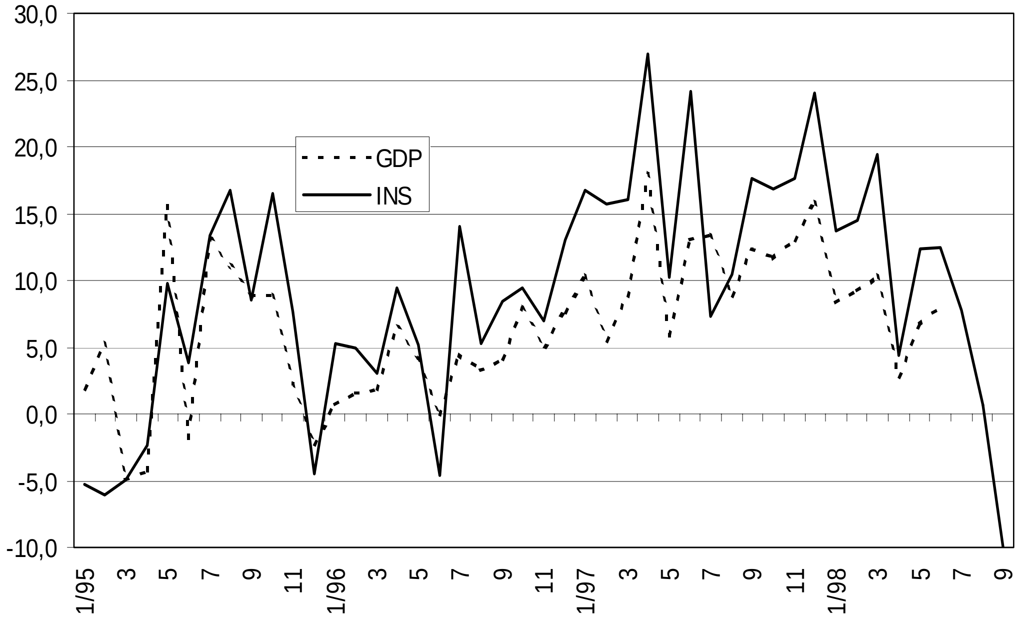


Chart 2 **IMP and GDP, year-on-year change, in percent**

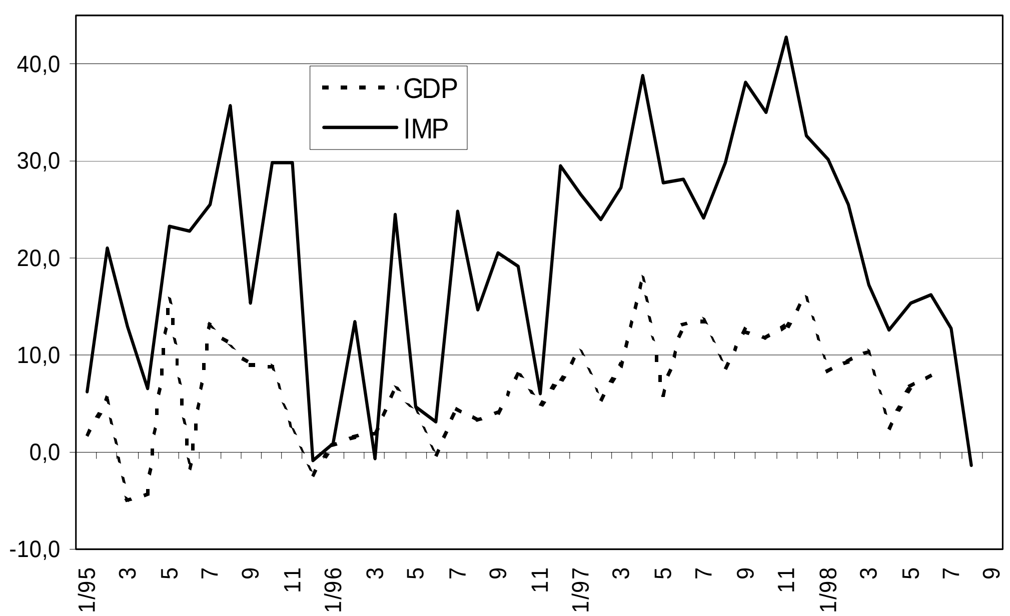


Chart 3 **LGR and GDP, year-on-year change, in percent**

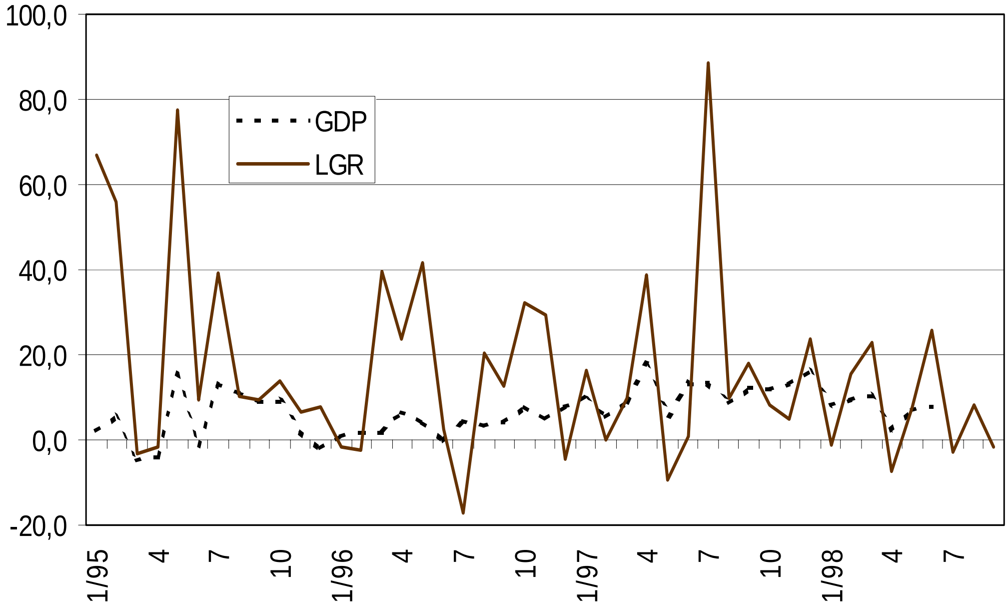


Chart 4 **M1 and GDP, year-on-year change, in percent**

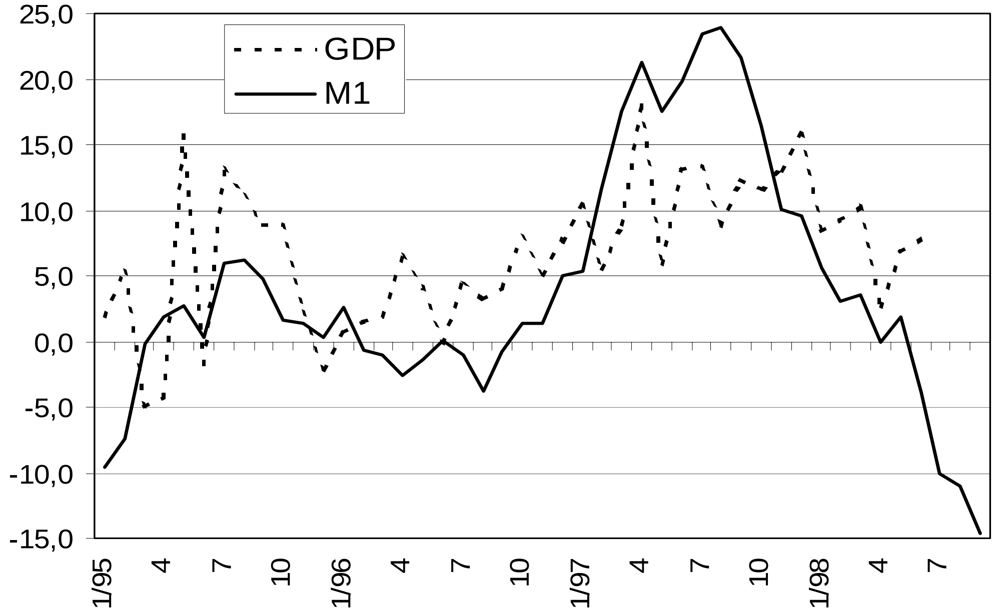


Chart 5 **ICI, year-on-year change, in percent**

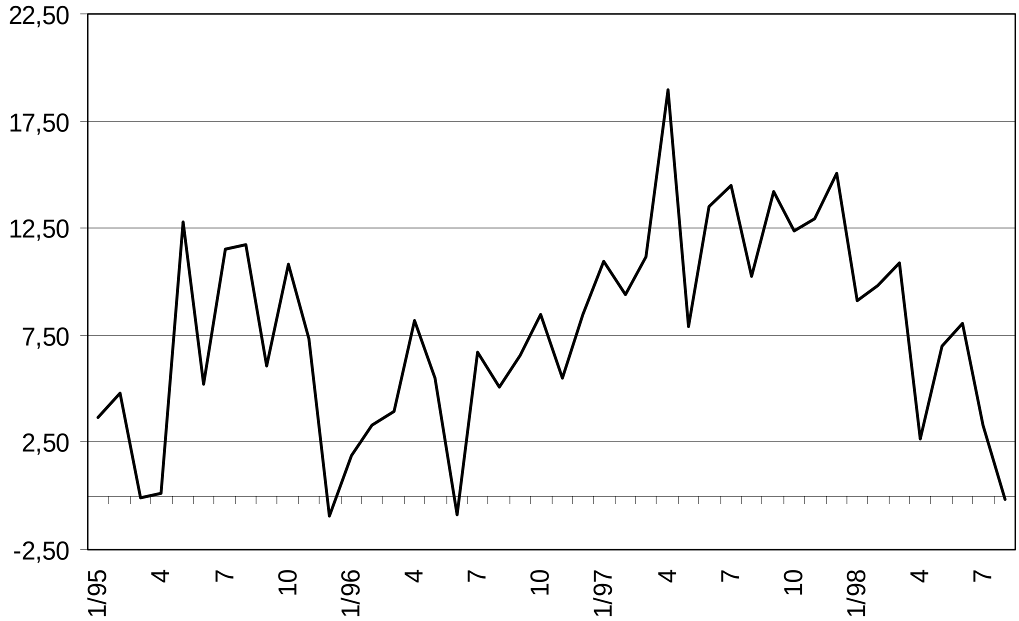


Chart 6 **ICI and GDP**

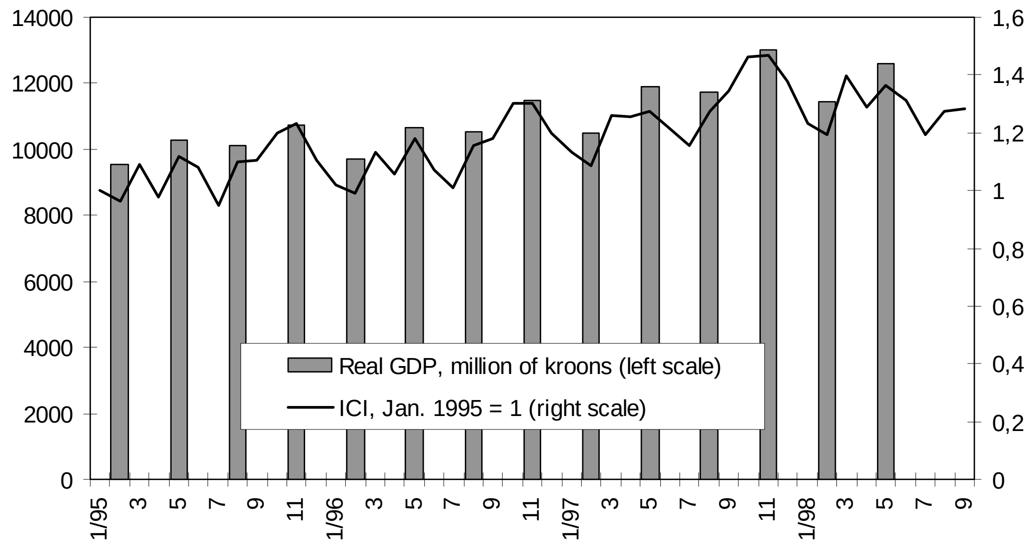
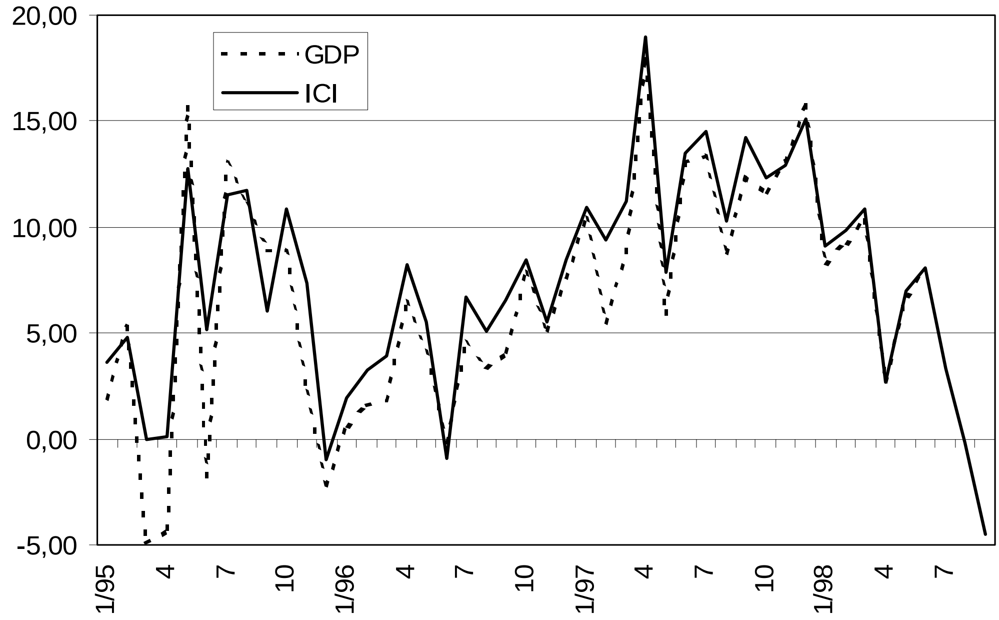


Chart 7 **ICI and GDP, year-on-year, in percent**



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