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A Leading Indicator for the Dutch Economy

Methodological and empirical revision of the CPB system

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Abstract in English

Since 1990, CPB Netherlands Bureau for Economic Policy Analysis (CPB) has used a leading indicator in preparing short-term forecasts for the Dutch economy. This paper describes some recent methodological innovations as well as the current structure and empirical results of the revised CPB leading indicator. Special attention has been paid to the role and significance of IFO data. The structure of the CPB leading indicator is tailored to its use as a supplement to model-based projections, and thus has a unique character in several respects. The system of the CPB leading indicator is composed of ten separate composite indicators, seven for expenditure categories (‘demand’) and three for the main production sectors (‘supply’). This system approach has important advantages over the usual structure, in which the basis series are directly linked to a single reference series. The revised system, which uses 25 different basic series, performs quite well in describing the economic cycle of the GDP, in indicating the upturns and downturns, and in telling the story behind the business cycle.

Key words: leading indicators, business cycles, filters

Abstract in Dutch

Het CPB gebruikt sinds 1990 een conjunctuurindicator bij het maken van prognoses voor de korte termijn. Dit Discussion Paper geeft een beschrijving van een aantal methodologische verbeteringen die onlangs zijn doorgevoerd en van de huidige structuur en de resultaten van de gereviseerde CPB-conjunctuurindicator. Daarbij wordt apart ingegaan op de betekenis en het belang van tijdreeksen van het Duitse IFO-instituut. De structuur van de CPB-conjunctuurindicator is toegesneden op het doel om gebruikt te worden als aanvulling op de ramingen die uit het macromodel voortvloeien en is daarom in meerdere opzichten uniek te noemen. Zo bestaat het systeem van de CPB-conjunctuurindicator uit tien componenten, waarvan zeven betrekking hebben op bestedingscomponenten ('vraagzijde') en drie op de belangrijkste productiesectoren ('aanbodzijde'). Deze benadering heeft belangrijke voordelen boven de gebruikelijke aanpak, waarbij de tijdreeksen direct in relatie worden gebracht met één enkelvoudige referentiereeks, zoals het BBP of de industriële productie. Het gereviseerde systeem met 25 verschillende basisreeksen geeft een redelijk goede beschrijving van de conjunctuurcyclus van het BBP, gelet op economische op- en neergangen, en is ook goed bruikbaar bij het rapporteren over de conjuncturele ontwikkeling.

Steekwoorden: voorlopende indicatoren,conjunctuur cyclus, filters

Contents

Summary

Since 1990, CPB has used a leading indicator for the Dutch economy. The structure of the CPB leading indicator is tailored to its use as a supplement to model-based projections, and thus has a unique character in several respects. The gross domestic product (GDP) has been used as the reference series. CPB is interested not only in ‘economic activity’ in general, as summarised in the GDP, but also in the development of key components of the economy. That is why the CPB leading indicator consists of subindicators for both expenditure categories (‘demand’) and production sectors (‘supply’). Public spending has also been included in the system as a separate expenditure category.

CPB’s methodology, based on the widely applied NBER methodology, uses so-called ‘deviation cycles’. The elimination of trend-based components from the time series used in this approach is an important aspect of this approach. A serious drawback of the application of a filter is known as the ‘end-point problem’, which arises because the addition of new or revised observations changes the filtered values of previous observations. Both graphical exercise and quantitative analysis show that the Hodrick Presscott filter is more sensitive to the end values than band pass filters. Of the two analysed band pass filters, the Christiano Fitzgerald (CF) filter performs better than the Baxter and King (BK) filter and is now used in the revised CPB leading indicator

From the many series considered 25 were selected for the 10 components of the CPB leading indicator. A clustering of these series shows that the different sources, namely international indicators, monetary variables, business surveys among manufacturers, business surveys in the construction industry, business surveys in the services sector, consumer surveys and other indicators contribute each between 10-15%. This leading indicator has a lead of 3 to 4 months. The indicator can track the cyclical development of the real GDP rather well. The correlation coefficient between the indicator and the reference series is 0.82. The main upturns and downturns are represented quite accurately by the indicators.
Seven variables have a lead time of nine months or longer. These variables are combined in a long-leading indicator, which makes it possible to look three quarters ahead. The ‘prediction’ for the longer time horizon is based on less information and should therefore be interpreted with particular caution.

Of the 25 selected indicators, 4 are based on economic developments in other countries. For an open economy like the Dutch, international economic conditions are very important. Both upturns and slowdowns in economic growth often receive an initial impulse from abroad. Just like the two selected OECD leading indicators for Europe and the US, the two selected IFO series contribute 6.5% to the CPB leading indicator of the Dutch economy. Compared to the

contribution of variables from surveys among Dutch manufacturers (15%), the contribution of the international indicators is limited. IFO data about the expectations among German manufacturers play a larger role (14.3%) in the CPB long-leading indicator.

The CPB leading indicator signals are compared to the projections based on the large-scale macro-econometric model used. This can lead to an adjustment of the model's projection by applying add-factors in specific behavioural equations, such as private consumption, investment or exports.

1 Introduction[1]

The large-scale econometric quarterly model SAFE plays a key role in the short-term projections for the Dutch economy prepared by CPB Netherlands Bureau for Economic Policy Analysis (CPB).[2] Since 1990, the CPB has also used a leading indicator for the Dutch economy, the so-called CPB leading indicator.[3] Since that time, the quarterly reports on the projections for the economy have also referred to the signal given by this indicator. The CPB leading indicator consists of two elements. The 'realisation' is meant to describe the actual development of GDP-growth in the Netherlands. The 'indicator' summarises all the available information of leading time series and is designed to give an indication of GDP in the near future and to signal turning points in advance.[4]

The structure of the CPB leading indicator is tailored to its use as supplementary to model-based projections, and has a unique character in several respects. Thus gross domestic product (GDP) is used as the reference series, and the system of the CPB leading indicator is composed of ten separate composite indicators, seven for expenditure categories ('demand') and three for the main production sectors ('supply'). A detailed study was conducted recently into the methods and techniques used. Particular attention was paid to the way in which time series are adjusted for their trend-based development and to the way in which the cyclical dynamics of a series can best be calculated.[5] Public spending was also included in the system as a separate expenditure category. And finally, all existing and potential new basic series were again tested for their predictive abilities. This has led to a situation in which the CPB leading indicator now uses 25 different basic series, including two series from the German IFO Institute. This CPB leading indicator has a lead of three or four months. From the 25 series, we selected 7 series which have a lead of at least nine months. These are aggregated to the 'long-leading' indicator, which has therefore a lead of three quarters to the reference series.

This paper is structured as follows. Section 2 examines the methodological innovations and the current structure of the CPB leading indicator. Section 3 considers the empirical results of the construction and pays particular attention to the role and significance of IFO data. The performance of the CPB leading indicator and its components is discussed in section 4. Finally, section 5 explains how the indicator is used in the preparation of the CPB's short-term projections.

[1] Sponsored by CES IFO, Munich. We would like to thank Gerard Ronning for his valuable remarks on the draft version of this paper. This draft version was presented at 'The Academic Use of IFO Survey Data Conference', 5-6 December 2003, Munich. The final paper is also published in Sturm, Jan-Egbert and Timo Wollmershäusen (editors), 'IFO Survey Data in Business Cycle and Monetary Policy Analysis', Physica Verlag, 2004 (forthcoming).

[2] See CPB (2003) for a description of the SAFE model.

[3] See Kranendonk (1990).

[4] In this paper the terms CPB leading indicator and composite indicator are used as synonyms.

[5] See Bonenkamp (2003).

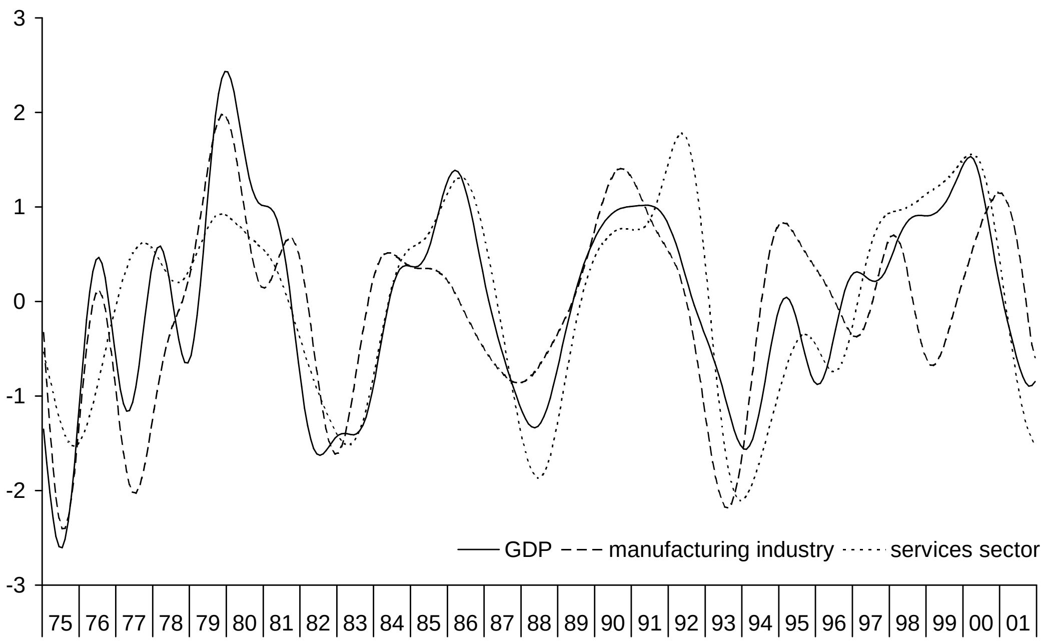
2 Methodology and structure

2.1 Choice of reference series

CPB's methodology, based on the widely applied NBER methodology, uses so-called 'deviation cycles'.[6] Deviation cycles regard cyclical movements as fluctuations around a permanent trend component. The first step is choosing a reference series which offers an appropriate reflection of economic activity. Manufacturing output is often used for this. The CPB leading indicator is the only Dutch economic indicator which uses the GDP as the reference series.[7]

On the assumption that the purpose of an economic indicator is giving an impression of overall economic developments in the future, the GDP is in principle a more suitable reference series than manufacturing output. After all, manufacturing output accounts for only 15% of the Dutch GDP, while the services sector accounts for 50% of the GDP. Although it must be said that the small share of manufacturing output as such does not need to be a reason for disqualification in this regard.

Figure 2.1 Economic cycles of GDP and the production of manufacturing industry and the services sector in the Netherlands[a]



[a] The series have been filtered with the band pass filter of Christiano and Fitzgerald. The selected bandwidth is 18-120 months.

[6] See e.g. Burns and Mitchell (1946) and OECD (1987).

[7] There are two other leading indicators for the Netherlands. The Dutch Central Bank uses manufacturing production as reference series and has selected five series (see Den Reijer, 2002). The Rabobank uses a composite index of five series for the description of the business cycle. Their leading indicator consists of five other series (see Assenbergh, 2000).

If the industrial sector is broadly as dynamic as the services sector, then the small share of manufacturing in the total economy is not a problem. Moreover, the GDP has a practical disadvantage in that the actual figures only become available on a quarterly basis, whereas manufacturing output figures are published every month.

Figure 2.1 shows the economic cycles of manufacturing output and the GDP for the years between 1975 and 2001. It also shows the performance of the services sector.

At a value of 0.70, the correlation coefficient between the manufacturing output and the GDP series is quite high. During the period under consideration, manufacturing output had an additional peak and through during the second half of the 1990s. It is also worth noting that the turning points in manufacturing output occurred earlier than those for the GDP, with the exception of the second half of the 1990s. Finally, the pattern of both series has varied sharply in recent years, as evident from a correlation coefficient of 0.17 between 1994 and 2001. Since 1994, the GDP was determined to a large extent by the development of the services sector, which deviated sharply from the performance of the industrial sector from that year. Until 1994, the cyclical pattern of the manufacturing industry and the services sector were quite comparable. At most turning points, the manufacturing industry is leading some months. After 1994, the resemblance is much lower, because the manufacturing industry shows three cycles and the services sector only one.

In short, up to and including the first half of the 1990s, the small share of the manufacturing output in the GDP is not a serious problem. Until then, the industrial and services sectors broadly moved in tandem, so that the development of manufacturing output provided a representative picture of the total economy's performance. But this situation changed in the second half of the 1990s. During this time the services sector developed more or less independently of the industrial sector, so that the dynamism of manufacturing output no longer provided a reliable guide to the dynamism of the economy as a whole. Thus, manufacturing output was no longer a reliable reference series.

2.2 Filters and the end-point problem

The elimination of trend-based components from the time series used is an important next step in the construction of an economic indicator based on deviation cycles. A serious drawback of the application of a filter is known as the 'end-point problem', i.e. which arises because the addition of new or revised observations changes the filtered values of previous observations. The end-point problem presents a serious handicap in the prediction of economic developments on the basis of leading series. In terms of the functionality of an indicator of economic activity, it is therefore very important to have an understanding of the sensitivity to new observations. This section examines, on the basis of empirical data, to what extent the sensitivity to new observations differs between filters. Three filters are compared, namely the Christiano and Fitzgerald (CF) filter, the Baxter and King (BK) filter and the Hodrick and Prescott (HP) filter.

The interpretation of the end-point problem differs from filter to filter. The HP filter calculates the trend component and identifies the cyclical component as the difference between the original series and the trend component. The end-point problem is therefore concentrated on changes in the trend component. This is different for the band pass filters, since these filters, given the standard decomposition of an economic time series in a trend-based, cyclical and disrupting component, calculate at least two components. The interpretation of the end-point problem is thus not restricted to a single component, as in the case of the HP filter.[8]
The fact that filtered observations change when new figures are added can lead on the one hand to changes in the intensity of the cyclical fluctuations at the end of the series, and on the other hand – and this is far more serious – to phase shifts. Depending on the type of filter, the end-point problem has two causes. To prevent observations dropping off at the end of the series, it is usual to expand the routine of a symmetrical filter with an extrapolation method. However, if the filtered values depend in part on artificial observations, it is hardly surprising that the addition of actual observations can bring about changes. An asymmetrical filter calculates the trend component at the end of the series on the basis of 'the past'. Consequently the availability of new figures will inevitably also lead to changes.

Filters

The Christiano and Fitzgerald (CF) filter and the Baxter and King (BK) filter are band pass filters. A band pass filter is a linear moving average which leaves cyclical fluctuations in tact while filtering out the high frequencies (month-to-month fluctuations) and low frequencies (underlying trend). The CF filter is an asymmetrical weighting scheme which uses all observations for the calculation of the filtered values.[a] The BK filter, on the other hand, is a symmetrical filter with a constant weighting scheme. In contrast with an asymmetrical filter, a symmetrical filter has a moving average with the same number of leads and lags. The advantage of a symmetrical filter lies in the prevention of phase shifts in the filtered series.[b] In contrast with the band pass filters, the Hodrick and Prescott (HP) filter only eliminates the low frequencies or long-term waves from a time series. The relationship between the variances of the trend component and the cyclical component, represented by the parameter λ, plays a key role in the HP filter.[c] The parameter λ determines the curve of the trend component. In case $\lambda = 0$, there is no difference between the trend component and the original series. As λ approaches infinity, the trend-based component begins to appear as a linear trend.

[a] See Christiano and Fitzgerald (2003).
[b] See Baxter and King (1999).
[c] See Hodrick and Prescott (1997).

Figures 2.2 to 2.4 illustrate the end-point problem on the basis of the cyclical component of Dutch exports. In each chart, one year (i.e. 12 monthly figures) is added systematically. The first month is December 1994 and the last month December 2001. In this case the HP filter has

[8] See Bonenkamp (2003).

λ = 129600, and the band pass filters have a bandwidth with 18 months as the lower limit and 120 months as the upper limit. These two input values are very comparable, so that differences in the sensitivity to the end values cannot be traced back to differences in the *extent* of filtering.

Figure 2.2 Cyclical component of exports – HP filter (λ = 129600)

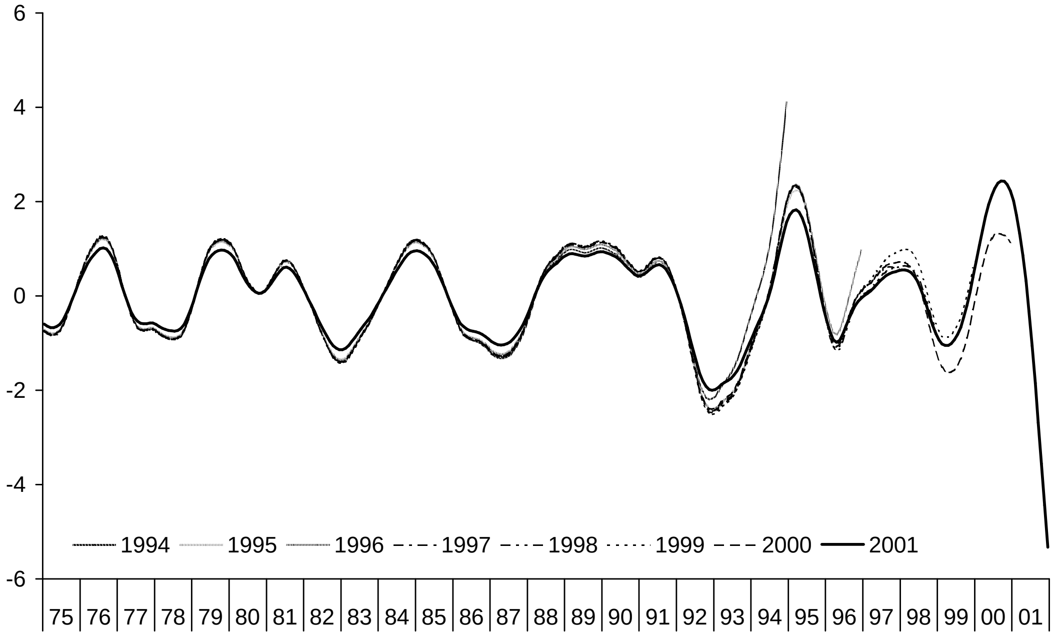


Figure 2.3 Cyclical component of exports – BK filter (bandwidth 18-120)

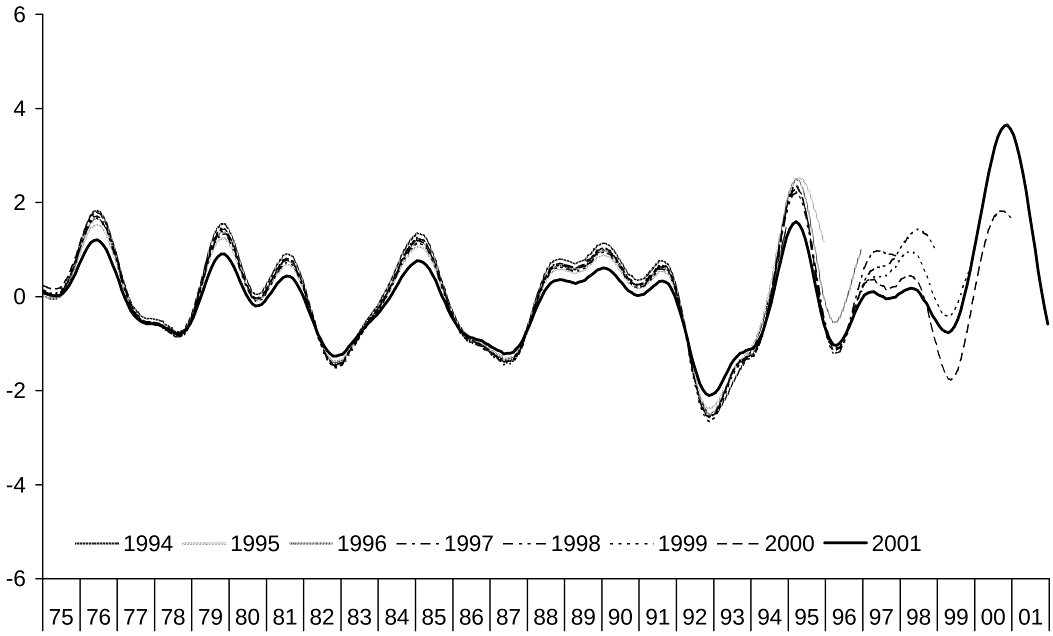
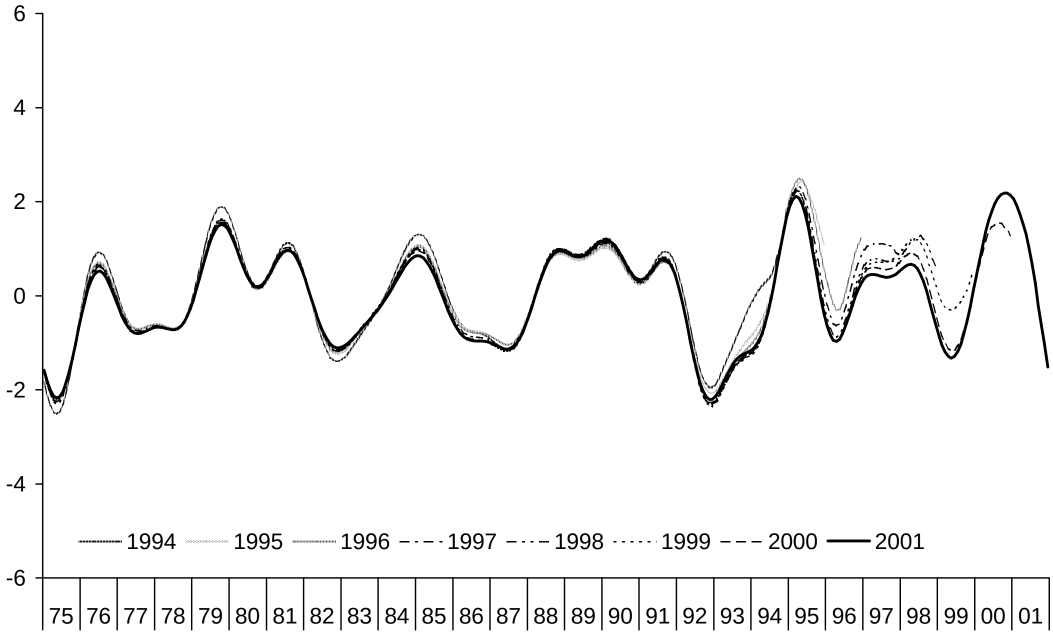


Figure 2.4 **Cyclical component of exports – CF filter (bandwidth 18-120)**



A comparison of figures 2.2 and 2.3 shows that, leaving aside the revisions arising from the addition of new observations, the three series move closely in line. This tallies with the general picture which emerges from the literature: no matter how different the filters in a technical and/or theoretical sense, the generated filtered series usually barely differ from each other.[9] But there are some differences, caused by the addition of new observations. The HP-filtered series shows a spike when 1994 is the final year which is not evident to the same extent in the other two series and which eventually, following the addition of new observations, proves to be a false signal. Bearing this in mind, the downward spike in 2001 may reveal more about the inadequacies of the HP filter than about the actual economic situation. The two other series also show downward phases in 2001, but these are significantly gentler than in the HP series. This drawback of the HP filter has already been highlighted by Giorno *et al*. (1995). It seems that the trend which this HP filter generates is too heavily influenced by cyclical developments in the recent past. In comparison with the HP- and CF-filtered series, the spike in 2000 in the BK series does not seem plausible. This may be related to the nature of the extrapolation method used in the BK filter.

This raises the question to what extent changes in the input values affect the end-point problem. For the HP filter this boils down to another value for λ, and for the band pass filters to another bandwidth. An increase in the value of λ has the same effect as a wider bandwidth. De Haan and Vijselaar (1998) argue that a high value for λ has a positive effect on the end-point problem. A higher λ implies a less flexible trend component, so that this becomes less

[9] See e.g. Zarnowitz and Ozyildirim (2002), Chadha and Nolan (2002) and Agresti and Mojon (2001).

susceptible to the inappropriate introduction of cyclical fluctuations. However, a higher λ or a wider bandwidth also has a downside. For there is a chance that a less flexible or too inflexible trend is not able to signal actual changes in that trend in time. This possibility is particularly likely in asymmetrical filters, because at the end of the series these filters are based exclusively on historical observations.

To gain a better understanding of the sensitivity of the three filters to the end-point problem, we carried out a formal sensitivity test, following Den Reijer (2002). We also examined to what extent a change in the input values plays a role. The selection of the input values followed on from the guidelines suggested in the literature. The CPB leading indicator uses monthly data. For the HP filter this meant, based on the work of Ravn and Uhlig (2002), a value of $\lambda = 129600$. In line with the arguments and selection by De Haan and Vijselaar (1998), $\lambda = 10^6$ was also included in the analysis. For the band pass filters this meant, based on Agresti and Mojon (2001), a bandwidth with a lower limit of 18 months and an upper limit of 120 months. Following Baxter and King (1999), a bandwidth with a lower limit of 18 months and an upper limit of 96 months was also used. The sensitivity of the filters to the addition of new observations was measured on the basis of 'revision errors' in the level of the cyclical component. That is to say, we examined to what extent a filtered observation at time t changes when a number of n year(s) of observations are added successively until T (T>t).

Absolute revision errors (RE) are calculated as follows:

$$RE_n = \left| LI_{t|t+n} - LI_{t|T} \right|$$

'LI' stands for 'leading indicator', and the symbols in this case have the following values: $t = 1994:12$, $T = 2001:12$ and $n = 0,1,....,7$. Equation (1) determines to what extent a filtered value at time t (given data until t+n) deviates from its 'real' value (given data until T). We assumed that a filtered value after seven years (which in the case of monthly figures means no fewer than 84 observations) will not change. Sixteen different time series were included in the analysis, such as GDP, the expenditure categories, manufacturing output, output in the services sector, the money supply, long-term interest rates, and the IFO indicator. Table 2.1 shows the average outcomes for these series.[10]

[10] For the outcomes of the 16 different series, see annex 1 in Bonenkamp (2003).

Table 2.1	**Revision errors in the level of the cyclical component** [a]							
Filter	n=0	n=1	n=2	n=3	n=4	n=5	n=6	n=7
HP_129600	1.12	0.50	0.24	0.12	0.11	0.10	0.09	0.00
HP_10^6	0.93	0.49	0.44	0.22	0.10	0.05	0.04	0.00
BK_18-96	0.58	0.45	0.20	0.11	0.10	0.10	0.05	0.00
BK_18-120	0.59	0.52	0.21	0.10	0.10	0.09	0.07	0.00
CF_18-96	0.44	0.30	0.12	0.08	0.06	0.06	0.05	0.00
CF_18-120	0.44	0.30	0.19	0.09	0.05	0.03	0.03	0.00

[a] The revision errors are averages calculated over the standardised cyclical components of 16 time series. The analysis was conducted with December 1994 (1994:12) as the first month and December 2001 (2001:12) as the last month.

The results from table 2.1 confirm the observations in figures 2.2 to 2.4. With regard to differences within the filters, or the effect of a change in the input values, the differences in the revision errors of both bandwidths in the CF and BK filters are too small to draw clear conclusions. The situation is different for the HP filter. The HP_106 filter performs better for $n = 0$, while HP_129600 performs better for $n = 1, 2$ and 3. From $n = 4$ both the revisions themselves and the differences between them are too small to draw any meaningful conclusions. The results for $n = 0$ correspond to the conclusion by De Haan and Vijselaar (1998) that an inflexible trend yields less significant revisions when new figures become available. But from $n = 1$ the downside of a high λ becomes evident. Compared to $\lambda = 129600$, the value $\lambda = 10^6$ is less able to signal actual fluctuations in the trend in time. These trend changes are picked up after an average of one year of observations ($n = 1$), which leads to revision errors exceeding those of HP_129600.

With regard to the differences between the filters, the most striking is doubtless the revision of the HP filter for $n = 0$. Regardless of the value of λ, the HP-filtered series deviate far more from their 'real' values than series which have been filtered with a band pass filter. Of the two band pass filters, the CF filter performs better than the BK filter; the revision errors in the CF filter are smaller, especially for $n = 0$ and $n = 1$. The suspicion already evident from figures 2.2 to 2.4 is confirmed when more than one series are included in the analysis. The symmetrical BK filter, which uses an extrapolation method to extend the series artificially, is more sensitive to the end values than the asymmetrical CF filter.

In short, both the graphical exercise and the quantitative analysis show that the HP filter is more sensitive to the end values than the band pass filters. Of the two band pass filters, the CF filter performs better than the BK filter. This sensitivity analysis is based on a single time moment. A repetition of this experiment for several time moments is an option for future research.[11] It does not seem very likely, however, that a dynamic analysis will change these findings significantly.

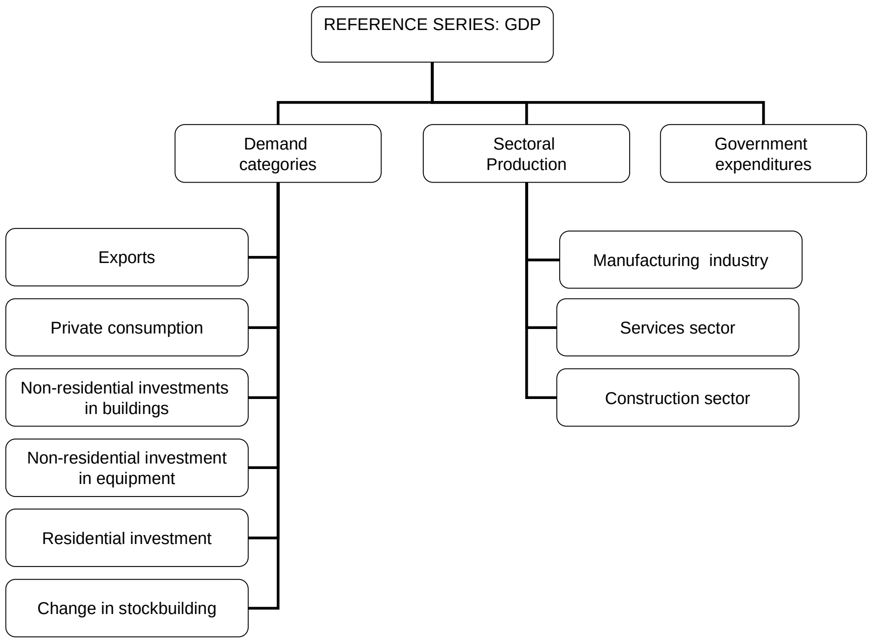
[11] Den Reijer (2002) conducted a dynamic sensitivity analysis for the HP filter (with $\lambda = 1.000.000$) and the CF filter (with a bandwidth of 18-120). He concludes that the differences between the two filters are small. It should be noted that this analysis was based on only a single time series.

After all, our experiment was based on several time series which, around the time moment at which the analysis was conducted, differed sharply in terms of their movements. On the basis of the above findings, the series in the revised CPB leading indicator are filtered with the CF filter. The bandwidth of 18-120 months has been retained, because a wider bandwidth makes it easier to distinguish between relevant cycles and irrelevant cycles.

2.3 Structure of the CPB leading indicator

The CPB is interested not only in 'economic activity' in general, as summarised in the GDP figure, but also in the development of key components of the economy. If growth accelerates, it is relevant to know whether the growth impulse originates from abroad or at home. It is also interesting to know in which sector or sectors growth accelerates first. That is why the CPB leading indicator consists of subindicators for both expenditure categories ('demand') and production sectors ('supply'). Public spending has also been included in the system as a separate expenditure category. This structure of the CPB indicator is quite unique, also by international standards.[12] Figure 2.5 shows the ten components which are distinguished in the CPB-system of leading indicators.

Figure 2.5 Composition of CPB leading indicator



[12] Several years ago a comparable version of the CPB system was applied to the Belgian economy. See Lebrun (1999).

CPB's approach has three advantages over the usual structure, in which the basic series are directly linked to a single specific reference series. First, the indicator provides more information, because it is possible to discover which expenditure categories or production sectors will underpin GDP growth in the future. It is thus easier to understand and tell the story behind the movements of the indicator. Second, because of its structure, the CPB leading indicator can be used as an instrument of verification. The indicator can be compared with projections resulting from the macro-economic model used, not only with regard to output, but also to consumption or investment for instance (see also section 5). Third, a detailed structure also offers more options to select series. Both series relating to demand components and to specific sectors can be examined. This gives a greater assurance that a theoretical correlation can be established between a reference series and a basic series.

The GDP is determined not only by expenditure and production in the market sector, but also by expenditure and production in the public sector. The original CPB leading indicator took no account of the latter. This is a drawback, certainly for those years when public spending makes a substantial contribution to GDP growth, as was the case in the Netherlands between 1997and 2002 for instance. For that reason the revised CPB leading indicator has been supplemented with a subindicator for the public sector. Government expenditure and production in a particular year (i.e. calendar year) are laid down in the Budget Memorandum, which is published in September of the previous year. The government budget outlined in the Budget Memorandum can be regarded as the best available leading indicator for public spending and output. It remains an indicator, because not all the plans unveiled by the government in the Budget Memorandum will be realised. Hence, new information is incorporated into this projection in the course of the year.
In the CPB system the reference series is thus separated in 10 components: six expenditure demand categories, three sectoral production variables and government expenditures (see figure 2.5). For each of these components an indicator has been constructed. The aggregate of these indicators is called the CPB leading indicator.

3 Composition

3.1 Selected series and weighting scheme

The process of selecting series to be used in the CPB leading indicator corresponds to the usual NBER methodology. After determining the cyclical component of each series, we then determined on the basis of cross-correlations and the predictive quality of dating turning points which series are usable and what the optimum lead time is. From the many series considered, we have selected 25 series as components of the CPB leading indicator eventually (see table 3.1).[13] In some areas it has been possible to include many indicators, but in others only three or four have proven suitable. The choice is very limited for private consumption and production of the services sector in particular.

The prediction horizon of the CPB leading indicator depends on lead times of the series and on the speed series become available with. On the basis of the composition presented in table 3.1, the prediction horizon is very limited. Some variables have a lead of only three or four months. Most of the variables also have a publication lag of one or two months. As a result, there is almost no effective lead for some variables. Dropping these variables would reduce the quality of the leading indicator. That is why we opted to 'extrapolate' a limited number of series in order to shift the prediction horizon several months. This is done by estimating a time series model (ARIMA) per series, and then predicting several months on that basis.[14] Table 3.1 shows which series are extrapolated. By application of this method we have a lead of least three months for each component, compared with the last realisations of the GDP.
There are several methods available for weighting the selected basic series in a composite indicator of economic activity:

- The method of principal components;
- Weighting with regression analysis
- Weighting scheme on the basis of correlations;
- Weighting scheme with equal weights

The first method, principal components analysis, is often applied in the context of indicators of economic activity. The indicators for the Dutch economy of the Dutch Central Bank (DNB) and the CCSO Centre for Economic Research, for instance, use this method.[15] This is an advanced multivariate technique which boils down to the optimum distillation of common fluctuations in a set of variables.[16] A drawback of principal components analysis is that this method does not

[13] The choice of the selected series is based on Bonenkamp (2003).
[14] See McGuckin, Ozyildirim and Zarnowitz (2003).
[15] See Berk and Bikker (1995) and Jacobs et al. (1997).
[16] For a brief technical exposition of the method of principal components, see Jacobs (1998), pp. 57-58.

take explicit account of the relationship between the basic series and the reference series, and this has to be 'predicted'.

Table 3.1 Composition and lead of CPB leading indicator's components

Expenditures		Lead	Sectors		Lead
Consumption	Retail trade confidence indicator	12	Manufacturing Industry	Production trend observed	5
	Economic climate	15		Money supply (M1, real)	13
	Bankruptcies[a]	3[b]		IFO business climate (expectations)	6
	Willingness to buy	12		OECD Leading indicator Europe	5
Exports	Exchange rate dollar euro	6[c]		Total inflow orders	7
	Money supply (M1, real)	13		Production expectations	6
	IFO business climate (expectations)	6			
	Long-term interest rate[a]	20	Construction Sector	Production tendency non-residential buildings	12
	OECD Leading indicator Europe	4		Production tendency residential buildings	14
	Inflow foreign orders	6		Buildings permits granted, private non-residential	6[b]
Non-residential investment (buildings)	Production tendency non-residential buildings	4		Buildings permits granted, residential	6[b]
	Buildings permits granted, private non-residential	3[b]		Long-term interest rate[a]	22
	Bankruptcies[a]	7[b]		OECD Leading indicator Europe	12
Non-residential investment (equipment)	Production tendency non-residential buildings	6		OECD Leading indicator US	16
	Capacity utilisation manufacturing sector	8	Services sector	Buildings permits granted, non-residential	4[b]
	Consumer confidence	4		Retail trade confidence indicator	9
	Inflow domestic orders	14		Bankruptcies[a]	4[b]
	Order position	8			
Residential investment	Production tendency residential buildings	6	Government	Government expenditure (CPB forecast based on Budget memorandum)	0
	Buildings permits granted, residential	5[b]			
	Long-term interest rate[a]	14			
Change in stock building	IFO business climate	7			
	Inflow domestic orders	7			
	Producer confidence manufacturing industry	9			

[a] Inverted.
[b] Series extrapolated with ARIMA-forecast.
[c] Exchange rate compared with twelve months ago

The weights can also be determined with the help of regression analysis. This method has the disadvantage that in theory it can only be applied when the variables are not linked to each other. But this condition can almost never be met in the case of an indicator of economic activity.[17] An alternative method uses correlation coefficients between a basic series and a reference series as weights. The advantage of this method is that series with a higher statistical correlation with the reference series also receive a heavier weighting. In the previous version of the CPB leading indicator the coefficients were calibrated in this way.[18]
The simplest method, and this is used by the OECD for instance, uses equal weights.[19]

Bonenkamp (2003) has shown that the results between the three methods do not differ that much. That is why, for the sake of simplicity, we have used equal weights in the weighting of indicators for the various components.

3.2 Aggregate

After the indicators have been constructed, with the help of the basic series, for the 10 different components, an aggregate is compiled which serves as the indicator for the GDP. To that end the subindicators have to be weighted. This is done in two stages. First the subindicators for the expenditure categories are weighted into an ‘expenditure indicator’ (left column in figure 2.5), and those for production sectors into a ‘production indicator’ (column in the mid of figure 2.5). These two indicators together constitute the two main components of the CPB leading indicator. These two components are merged with public spending into the aggregate.

How is the weighting scheme determined? Until recently, the expenditure categories were weighted at their nominal share in total expenditure, with an adjustment for the different variances of the components. In this way, investments were given a slightly heavier weighting, because their cyclical fluctuations are relatively large. Conversely, the weighting of consumption was reduced somewhat. The production sectors were weighted in the same way, that is, at their nominal shares in total output.

In the course of the project on the revision of the CPB leading indicator we found that this method yielded disappointing results. For more recent years in particular, the aggregated indicator did not adequately reflect the actual economic situation. The reason why the old method did not function properly may well be related to the changed filter method. After all, there is no guarantee that weighting components which have been filtered separately will yield

[17] Correlation of the regressors leads to multicollinearity. Consequently the estimated coefficients are unbiased, but they have a high standard error. Thus the information value of the coefficients is low.
[18] See Kranendonk (1990), p. 30.
[19] See OECD (1987).

the same result as filtering the trend component directly from the aggregate of those components.[20]

The current approach for weighting into the CPB leading indicator is based on regression analysis. By regressing the actual series for the GDP components (both expenditure categories and production sectors) on the actual GDP series, we have tried to estimate the optimum weighting. We have only used the cyclical components of the series. Unfortunately unrestricted regression leads to negative shares for the smaller components of the GDP, such as public spending, residential investment and other private non-residential investment. Setting the weights of these smaller components at 5%, yielded plausible weights, which have been included in table 3.2.

Table 3.2 Structure of CPB leading indicator (in %)

Reference series	Expenditures	Sectoral production	Total
Exports	25.0		10.6
Private consumption	40.0		17.0
Non-residential investment in buildings	10.0		4.3
Non-residential investment in equipment	5.0		2.1
Residential investment	5.0		2.1
Change in stock building	15.0		6.4
Total expenditures			42.5
Manufacturing industry		30.0	15.8
Services sector		55.0	28.9
Construction sector		15.0	7.9
Total sectoral production			52.5
Government expenditures			5.0
Total (GDP)	100	100	100

By combining the information in the tables 3.1 and 3.2 it is possible to infer the weighting of the basic series in the composition of the CPB leading indicator. In table 3.3 the series are clustered in a number of different sources from which the indicators can be obtained, namely international indicators, monetary variables, business surveys among manufacturers, business surveys in the construction industry, business surveys in the services sector, consumer surveys, and other indicators. The table shows that three of the 25 series have a relatively heavy weighting of more than 10%, namely business confidence in the retail sector, the number of bankruptcies and the number of permits for industrial and commercial buildings. This is because only three series have been selected for ‘production in the services sector’ and ‘private consumption’, and these two categories have a considerable share in the total. Partial

[20] Incidentally, this was not guaranteed either under the phase-average-trend (PAT) filter method applied until recently.

comparisons of the basic series confirm, however, that these series are more closely correlated with the GDP than the other series. That is why we have decided not to reduce the weighting of these three series.
The clustering of the series shows that the various sources each contribute between 10 and 15%. This indicates that the CPB leading indicator is based on a broad range of information with a relatively balanced composition.

Table 3.3 Weight of the indicator series in the CPB leading indicator and long-leading indicator

Series	CPB leading indicator	Long-leading (lead in months)
International indicators	13.0	
IFO business climate	2.1	
IFO business climate (expectations)	4.4	14.3 (9)
Leading indicator Europe (OECD)	5.4	
Leading indicator US (OECD)	1.0	
Monetary variables	11.0	
Exchange rate dollar euro	1.8	
Money supply (M1, real)	5.4	14.3 (13)
Long-term interest rate (inverse)	3.5	14.3 (20)
Business surveys manufacturing industry	15.0	
Capacity utilisation rate manufacturing industry	0.4	
Production trend observed	2.6	
Inflow domestic orders	2.6	
Inflow foreign orders	1.8	
Total inflow orders	2.6	
Order position	0.4	
Producer confidence manufacturing industry	2.1	
Production expectations	2.6	
Business surveys construction	5.0	
Production tendency non-residential buildings	2.8	
Production tendency residential buildings	1.7	
Business surveys services sector	14.0	
Producer confidence retail sector	13.9	14.3 (10)
Questionnaire amongst consumers	9.0	
Consumer confidence	0.4	
Economic climate	4.3	14.3 (15)
Willingness to buy	4.3	14.3 (12)
Other indicators		
Bankruptcies (inverse)	15.3	
Buildings permits granted, non-residential	12.0	14.3 (10)
Buildings permits granted, residential	1.7	
CPB-forecast government expenditure	5.0	
Total	100	100

3.3 Long-leading indicator

Table 3.1 shows that many of the series have a lead time of four to seven months. Bearing in mind the delayed availability of information and the extension of some series, this makes it possible to detect a turnaround at most one or two quarters ahead. However, there are also a number of variables with lead times of nine months or longer. These variables make it possible to look three quarters ahead. But because only a limited number of series are involved, these series are only combined for the aggregate (GDP) and not for the individual components. To that end, we have determined the optimum lead time in relation to the GDP, and we did not take the lead time from table 3.1. Table 3.3 includes the composition of this long-leading indicator in the right-hand column, with the lead time shown in brackets. A summary of the whole system of indicators in model form is provided in annex 1.

3.4 Role and significance of IFO data

Of the 25 selected indicators, four are based on economic developments in other countries.[21] For an open economy like the Dutch, international economic conditions are very important. Both upturns and slowdowns in economic growth often receive an initial impulse from abroad. After a certain time lag, this has a ripple effect in consumer spending and/or private non-residential investment. When the economy is in recession, as it was in 2003, it therefore makes sense to analyse indicators from other countries to see whether they give off any signs of recovery. Since Germany is the destination of around 25% of Dutch goods exports, an indicator for the Dutch economy should pay special attention to German leading indicators.

Ever since its introduction in 1990, the CPB leading indicator has relied on two major international sources of indicators, the OECD and the IFO. The CPB indicator uses OECD's leading indicators for Europe and the United States. These serve as proxies for the general international climate. The CPB indicator has also used the IFO's business climate indicator for German manufacturing industry. As part of the revision of the CPB indicator, we have analysed the contribution of the IFO indicator in detail. The findings are discussed in this section.

The business climate for the German economy was included in 1990 as an indicator for non-energy exports and for manufacturing output, in both cases with lead times of five months. In the course of the recent study it emerged that the optimum lead time was now only a few months, which may be related to shorter production and delivery times. The current method diverges in three ways from the approach adopted in 1990, with the first point having a particularly significant bearing on the outcomes:

[21] These are the OECD's leading indicators for Europe and the United States and the German IFO's business climate indicator and its component on expectations for the near future (see table 3.1).

- The trend-based development has now been eliminated with a different filter technique. In the past, the phase-average-trend (PAT) method was used; since the revision the Christiano-Fitzgerald filter has been used (see section 2.2).
- In the past the business climate indicator was not adjusted for the trend; now it is.
- The time series for exports and manufacturing output have been changed twice since 1990 as a result of international revisions of the national accounts.

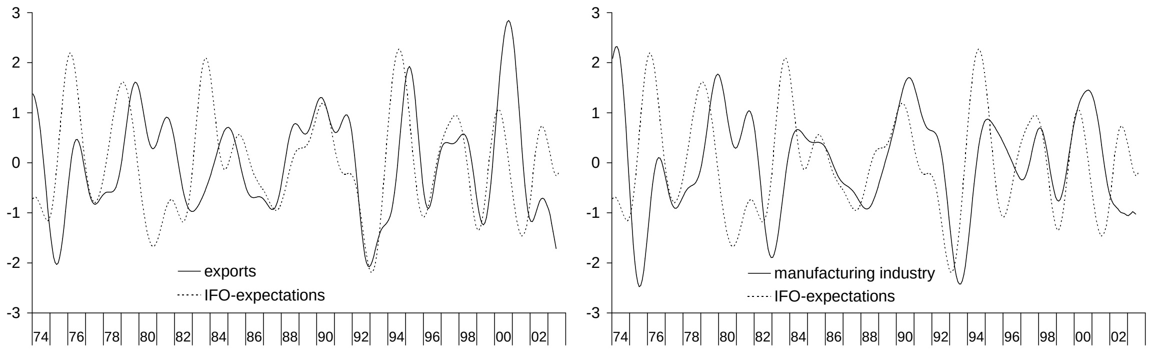
With the current series and filters the lead time is only two to three months. This is not long enough to be of any use. That is why we have analysed separately the two questions of which the business climate indicator is composed, namely an assessment of the current situation and the expectations for the near future. Table 3.4 shows that the question relating to expectations for the near future has a lead time of six months or longer. Partly on the basis of an analysis of turning points, the expectations variable has been included in the revised CPB leading indicator with a lead time of six months (see table 3.1). The question relating to the current situation has no lead time and therefore cannot be used. It is also apparent from the table that in recent years the expectations question has been much more closely linked to the reference series, since the correlation coefficient has been risen from 0.3-0.4 in the first period to around 0.75 in the second period.

Table 3.4 Correlation IFO-series with exports and manufacturing industry

	Correlation		Lead (months)	
	1975-1988	1989-2002	1975-1988	1989-2002
Exports				
IFO business climate	0.61	0.80	2	2
* Current situation	0.71	0.80	0	– 1
* Expectations	0.25	0.76	7	6
Manufacturing industry				
IFO business climate	0.74	0.85	4	3
* Current situation	0.84	0.86	3	0
* Expectations	0.38	0.74	9	7

Figure 3.1 shows that the correlation was weaker during the first half of the 1980s in particular, but that it was much stronger between 1986 and 2000. This applies both for the dating of the turning points and for the intensity of the fluctuations. A striking aspect in recent years is that the upswing for 2002 flagged up in the expectations question of the business climate survey did not materialise, probably partly due to geopolitical uncertainties.

Figure 3.1 Cyclical pattern of exports, manufacturing industry and IFO-expectations[a]

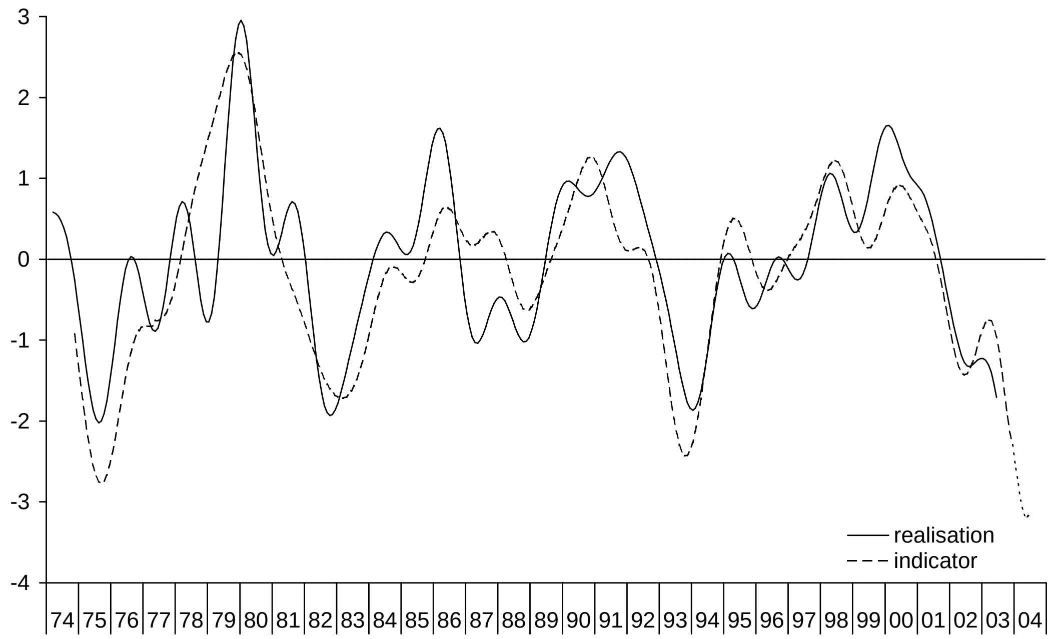


[a] IFO-expectations not moved with optimal lead.

4 Performance of the CPB leading indicator

Section 3 explains the composition of the CPB leading indicator. In this section we will briefly discuss the result. In figure 4.1 the ‘realisation’ line represents the economic cycle of the GDP. The indicator, based on the 25 selected series, can track this line quite accurately. The correlation coefficient between the indicator and the reference series is high, 0.82. The main upturns and downturns are represented quite accurately by the indicators. Only the subcycles during the mid 1970s are not recorded.[22] The intensity of the cyclical upward and downward phases in the indicator corresponds more or less with the actual fluctuations. In most cases the turning points are predicted reasonably accurately, but on several occasions the turnaround is signalled too soon (the peak in 2000) or too late (the trough in 1989). These ‘misses’ show that the instrument should be used with a degree of caution.

Figure 4.1 CPB- leading indicator, 1974-2003[1]



[1] Date of calculation is December 2003.

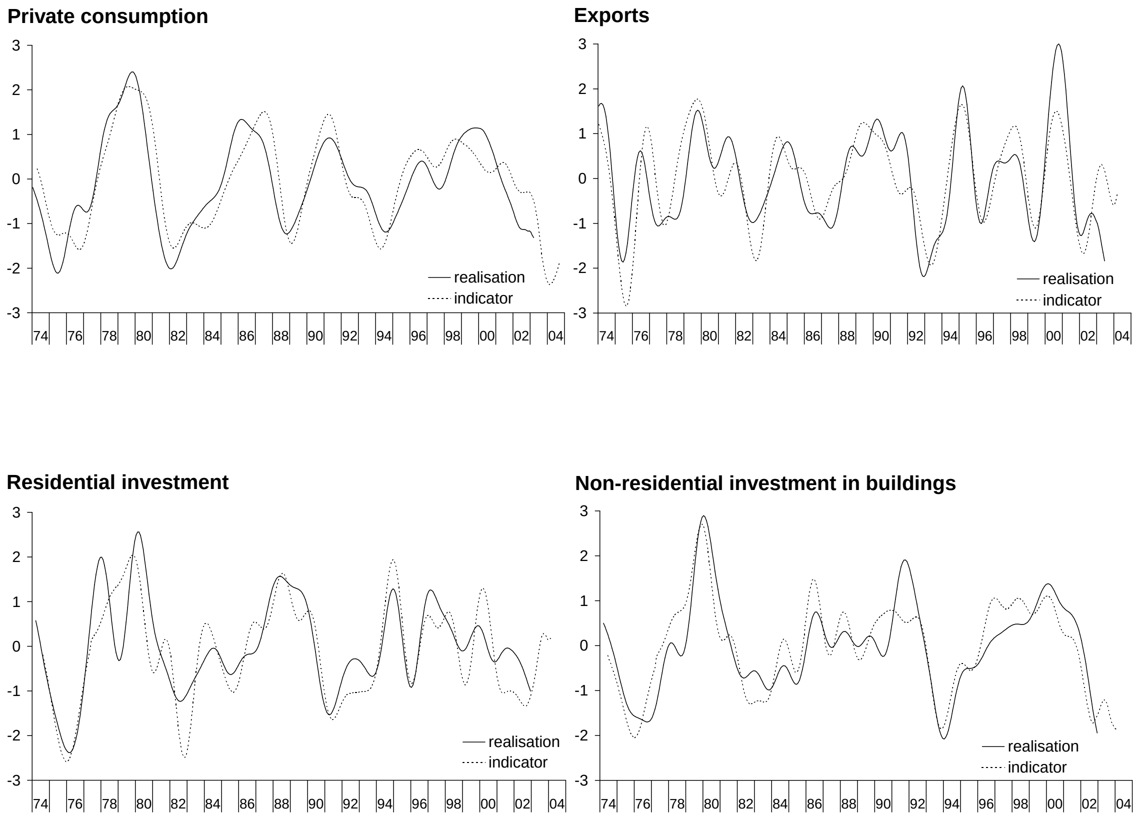
The figure also includes the long-leading indicator. To prevent the three lines – realisation, indicator and long-leading indicator – intertwining too much, we have opted for a presentation in which the dynamic of the long-leading indicator is added to the most recent observation of the normal indicator. In the figure, the dashes are based on the CPB leading indicator, and the dots for the most recent months are derived from the long-leading indicator. We have deliberately opted for a change from dashes to dots, because the seven series constituting the long-leading indicator account for only half of the total information. The ‘prediction’ for the

[22] Incidentally, in the selection process the early years were weighted less heavily.

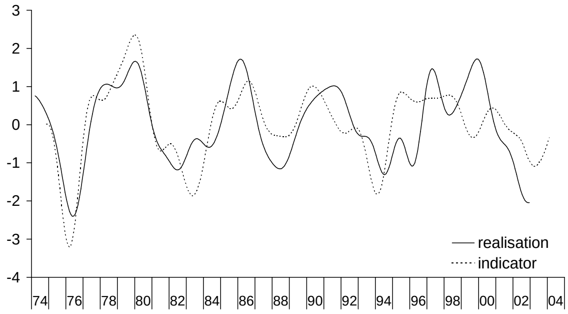
longer time horizon (more than three months ahead, say) is thus based on less information and should therefore be interpreted with particular caution.

Figure 4.2 shows the actual outcomes and the leading indicators for the 10 components of the CPB leading indicator. They illustrate that the cyclical patterns differ significantly between categories. Private consumption, for example, has only four cycles during the period 1974-2003, while export shows seven cycles. The indicators for most components perform quite well measured by the number of cycles and the dating of turning points. The performance of the change in stock building is relatively poor, probably caused by statistical measurement problems. The horizon of the indicators of the components differs, depending on the lead of the selected basic series. The indicator for private consumption has in December 2003 information up to September 2004, but most of the other indicators are not further available then up to February or March 2004.

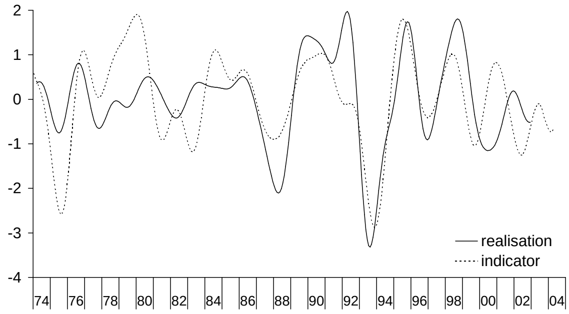
Figure 4.2 Components of the CPB leading indicator



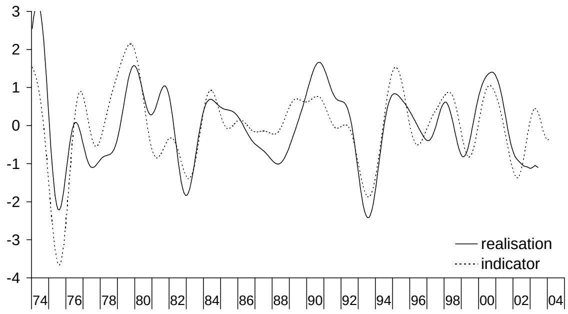
Non-residential investment in equipment



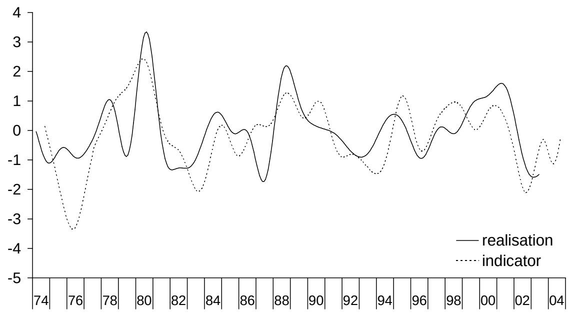
Change in stockbuilding



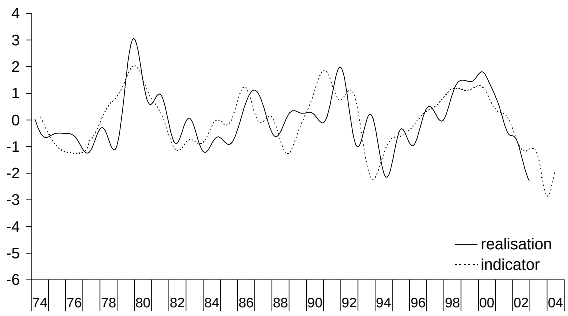
Production manufacturing industry



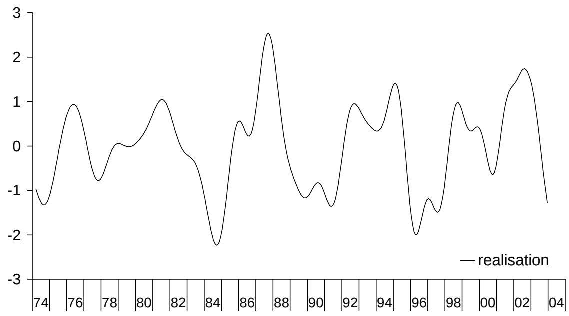
Production construction sector



Production services sector



Government expenditures



5 Application in practice

Each quarter, the CPB publishes a projection of economic growth for the current and the following year. The quarterly model SAFE plays a key role in the preparation of the forecasts.[23] This model is fed with data covering the past and with exogenous assumptions on international developments and on the government's economic policies. Other information sources, such as the views of experts, are also used in estimating the economy's performance. Figure 5.1 shows the process in schematic form. A key feature is that the preparation of the projections is an iterative process, in which the model assures consistency.[24] The projections are adjusted via the autonomous terms in the model. This means that the outcomes for specific behavioural equations, such as private consumption, investment or exports, can be adjusted if necessary. The advantage of this procedure is that the model calculates the consequences for all variables if an adjustment is made for a specific variable.

Information from the CPB leading indicator sometimes prompts an adjustment of the model's projection. The model makes projections on a quarterly basis and takes as much account as possible of the actual outcomes published by Statistics Netherlands (CBS) at regular intervals. Often, the indicators provide some information on those quarters for which CBS has not yet published any figures. That is why the signal of a possible turning point in the CPB leading indicator is compared with the profile based on the model's projection. For the current quarter and the following two quarters the analysis attaches considerable weight to an acceleration or deceleration of growth as indicated by the barometer.

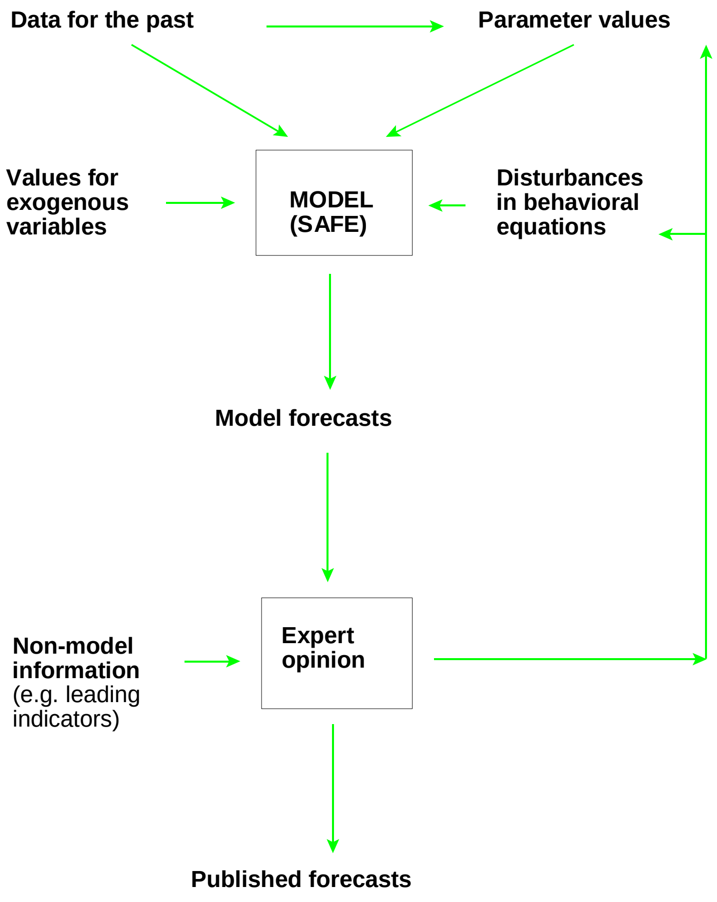
This can be illustrated with two examples. A relatively positive development of disposable household incomes leads to an optimistic projection for household consumption. But if households report in the monthly survey that they do not have much confidence in the economic outlook or if they are pessimistic about their own financial situation, this signal could lead to a more cautious projection of consumer spending than would have happened purely on the basis of the relevant economic variables.

Similarly it may be necessary to temper the projection for exports if Dutch businesses are still pessimistic about orders received from abroad. In section 3.4 we highlighted the usefulness of analysing international indicators in addition to Dutch indicators and of seeing what signals they give off. Because of the importance of developments in Germany, strong or weak confidence among German manufacturers, as reflected in the expectation component of the IFO business climate indicator, may thus give sufficient reason to reconsider the model's export projection and perhaps to adjust it.

[23] See CPB (2003).

[24] For more information, see Kranendonk and Jansen (1997).

Figure 5.1 Process of making short-term forecasts at CPB



Annex 1 System of equations CPB leading indicator

Consumption:

e = [dol(-6) + ifoe(-6) + lieur(-4) – rl(-20) + m1(-13) + oif(-6)] / 6

cp = [cret(-12) + ecc(-15) – br(-3) + wtob(-12)] / 4

ib = [bpn(-3) + ptn(-4) – br(-7)] / 3

ie = [cap(-8) + ptn(-8) + ccon(-4) + oid(-14) + orp(-8)] / 5

ir = [bpr(-5) + ptr(-6) – rl(-14)] / 3

st = [ifo(-7) + oid(-7) + mcon(-9)] / 3

Sectors:

ymi = [prto(-5) + ifoe(-6) + lieur(-5) + m1(-13) + oit(-7) + ptm(-6)] / 6

yci = [ptn(-12) + bpn(-6) + stfp(-10) + bpr(-6) + ptr(-14) + lieur(-12) + lius(-16) – rl(-22) + m1(-13) + orp(-7)] / 10

yserv = [bpn(-4) + cret(-9) – br(-4)] / 3

yexp = 0,25 * e + 0,40 * cp + 0,10 * ib + 0,05 * ie + 0,05 * ir + 0,15 * st

ysec = 0,30 * ymi + 0,55 * yserv + 0,15 * yci

conjind = 0,425 * yexp + 0,525 * ysec + 0,05 * gov

ll = [cret(-10) + ecc(-15) + ifoe(-9) + wtob(-12)˜ rl(-20) + m1(-13) + bpn(-10)] / 7

Explanation abbreviations:

conjind CPB leading indicator
cp private consumption
e exports of goods excluding energy
gov government expenditures
ib non-residential investment in buildings
ie non-residential investment in equipment
ir residential investment
ll long-leading indicator
st change in stock building
yci production construction industry
yexp production, expenditure approach
ymi production manufacturing industry
ysec production, sectoral approach
yserv production services sector

Indicators:

bpn	buildings permits granted, non-residential
bpr	buildings permits granted, residential
br	bankruptcies
cap	capacity utilisation
ccon	consumer confidence
cret	retail trade confidence indicator
dol	exchange rate dollar euro
ecc	economic climate
ifo	IFO business climate (manufacturing industry)
ifoe	IFO business climate (expectations, manufacturing industry)
lieur	leading indicator Europe (OECD)
lius	leading indicator United States (OECD)
mcon	producer confidence manufaturing industry
m1	money supply (M1, real)
oid	inflow domestic orders
oif	inflow foreign orders
oit	total inflow orders
orp	orderposition
prto	production trend observed
ptm	production expectations
ptn	production tendency non-residential buildings
ptr	production tendency residential buildings
rl	long-term interest rate
wtob	willingness to buy

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