A conditions monitor for fixed capital formation

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Explanation of symbols

.	= data not available
*	= provisional figure
x	= publication prohibited (confidential figure)
–	= nil or less than half of unit concerned
–	= (between two figures) inclusive
0 (0,0)	= less than half of unit concerned
blank	= not applicable
2005-2006	= 2005 to 2006 inclusive
2005/2006	= average of 2005 up to and including 2006
2005/'06	= crop year, financial year, school year etc. beginning in 2005 and ending in 2006
2003/'04–2005/'06	= crop year, financial year, etc. 2003/'04 to 2005/'06 inclusive

Due to rounding, some totals may not correspond with the sum of the separate figures.

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A conditions monitor for fixed capital formation

Floris van Ruth

Summary: A system is proposed to monitor economic conditions relevant for the development of fixed capital formation. By tracking the development of a coherent set of related indicators, private fixed capital formation development can be analysed and underlying trends made visible. It is shown that by using a careful selection process, an indicator set can be constructed which can communicate a lot of relevant information in a concise manner. The indicators are presented in a graphic form, for easy and quick interpretation by the users. A time function and other functionalities should be added to a web-based application to further enhance the utility of the product.

Keywords: Business cycle, short term economic indicators, fixed capital formation, indicator sets, data visualization

1. Introduction

The economy is characterized by many cross-relationships between economic indicators. This can both be bewildering and useful. The diversity of economic phenomena is reflected in the wide array of economic statistics published by various agencies. This paper proposes a method which will show important relations in the economy and at the same time introduce a measure of structure into the broad supply of statistical indicators. The basic idea is to take three core indicators of the economy and using economic relations, construct around each of them a system of related statistical indicators. This system then functions as an analytical tool, putting the reported statistics into context and allowing for more in-dept analysis of the realisations. The core indicators selected for monitoring are consumption, exports and fixed capital formation, which together largely describe the expenditure side of the economy. Together they drive medium term economic developments, if not the structural ones. This paper concerns the construction of a conditions monitor for the development of private fixed capital formation. It is part of a set of three papers, one for each of the core economic indicators singled out here. A consequence of this separated approach is that there is considerable overlap in the general sections of the three papers.

The related indicators will assist in analyzing and interpreting realisations of the core indicators, showing the influences working at any given time. Given the observed conditions, smaller or larger realisations of the growth rate of private fixed capital formation will be more likely. Thus, one can assess whether an observed development is normal or abnormal and likely to persist. A somewhat more advanced, and interesting, application is to use the conditions monitor to analyze how the developments in the different factors underpin the observed realisations of the target indicator. This allows a more structured and objective analysis of the developments in private fixed capital formation, and give insight in the underlying trends. The concept of publishing statistical indicators in coherent sets is not only useful because it helps structuring statistical dissemination via the explicit ordering of statistical information. Important is also that showing indicators in context of other statistics adds value to the individual indicators by demonstrating that developments are not random but part of a larger system. This makes it easier to interpret the developments of individual indicators and displays the underlying trends.

The actual form of the monitoring system is a separate issue from the fundamental concept of using a coherent group of indicators to track certain developments, and from the selection of these indicators. Having obtained a functioning indicator set, there are numerous methods for displaying them and communicating the information they contain. One could for example opt for computing a form of aggregate indicator, or for displaying the indicators separately either in graphs or symbols. Here, it is required that the conditions monitor should be easy and quick to interpret, show the maximum amount of information while still being comprehensible and it should be possible to ad interactive feature to increase its utility for the users. Therefore, it is proposed to use a graphic approach, constructing a diagram which jointly shows the development of the selected indicators.

2. Methodology

The aim is to construct a tool for analyzing and visualizing the conditions for the development of the volume of private fixed capital formation. The development of an economic quantity such as fixed capital formation is usually influenced by a number of different factors. Generally, this is a complex process and which factors are most important at a certain time tends to be uncertain. However, together these factors will broadly account for the observed behaviour of the target variable, here fixed capital formation. The basic idea here is to jointly show the development of these factors, thus giving an indication of what conditions are like for fixed capital formation. This requires some clarification as to what is meant by conditions and how these are to be measured. Broadly speaking it means the aggregate development of those economic quantities which have a strong influence on the development of fixed capital formation. In general all economic variables are connected, directly and indirectly influencing each other. This means that the majority of the economic indicators tend to develop broadly in line most of the time. This is not very helpful, as monitoring all economic indicators or general economic conditions will only result in confusion or very unspecific, bland analysis. The key words are “broadly” and “most of the time”, for there are of course economic variables which are directly or causally connected, and much more which are connected only by the general development of the economy. Another way of looking at this is that the development of a specific indicator is the net result of the combined influence of a number of relevant other economic quantities. But the importance and timing the influence of each quantity will vary in time. On the other hand, macro-economic models used for forecasting tend to need a surprising small number of variables to predict the development of quantities such as fixed capital formation. This is not very helpful in constructing a conditions monitor for two reasons. The modelling environment is required to add additional information to the raw indicators, just publishing these indicators will give an imperfect reflection of the conditions for the target indicator. And the goal is a system which will show the developments in the whole relevant economic environment, not just the two or so most important indicators. This will allow for a richer analysis and lessen the chance of missing an important development.

It should now be emphasized that the aim is not to construct a prediction model, or even a behavioural one. The conditions monitor will not be able to give a quantitative explanation of certain realisation of the target indicator, nor is it designed to do that. The start of this approach is the identification of (general) factors which are important for the development of the target indicators. The key step is finding indicators which reflect these factors. These will form the backbone of the monitoring system. As we are not trying to model or forecast the target indicator, the related indicators need not be leading or be jointly significant. The main conditions are a clear link with one of the underlying factors, a significant individual relationship with the target indicator and being able to give relevant current information. This last condition means that even if a related indicator is lagging, it still can be included if the coincident realisation contains enough relevant information. Thus, the selection process can be summarised as follows:

• Use theory and existing knowledge to identify factors which are relevant for the target indicator, here fixed capital formation.

• Make a first selection of indicators which are connected to or representative of the identified underlying factors

• Test the candidate related indicators for their connection with the target indicator. This is a multi-step process:

- Compute the maximum correlation of the candidate related indicator with the target indicator.
- Estimate whether the candidate indicator is significant in an ARMAX-model (an ARMA model with exogenous variables) of the target indicator. This is the crucial step in the selection process, as it tests whether the related indicator has a non-spurious link with the target indicator. The ARMA-component of the model will use the information available in the past development of the target indicator itself. Thus, if the related indicator is significant in the ARMAX-formulation, this means it contains new information and the identified relationship is unlikely to be caused by general co-movement. Another way of looking at this is that the related indicator is a source of impulses to the target indicator.
- Compute out-of-sample forecast errors to test the strength of the relationship
- Jointly evaluate the selected indicators to test how well the whole represents the target indicator and the identified factors. There are several ways to do this; e.g. principal component analysis, computing the average of standardized realisations, multivariate regressions or ARMAX.

When this process is completed, the result will be a *diverse* set of indicators with a proven and substantial link with the target indicator. The next step is how to construct a conditions monitor from this. There is no one superior method to do this. Together, the related indicators should reflect all important factors influencing the target indicator. How to extract and present this information is separate from the concept and selection of this group of related indicators. One could chose from different types of disaggregated graphical presentations, or compute an aggregated index, or give a "conditions score". It depends on what one wishes to achieve. Our approach and the thoughts behind it will be presented in section 4, after the results of the selection process.

3. Indicator selection

3.1 Factor identification

One could argue that there are broadly speaking two main motives for capital expenditure. I term these “the need to invest” and “the opportunity to invest”. The need to invest comprises both capital replacement and capital enlargement. The first aspect is driven by the wearing out or becoming obsolete of capital goods. This type of capital expenditure will mainly depend on general economic conditions, as it can be delayed but not avoided. An entirely different reason why capital expenditure can become necessary is at high rates of capacity utilisation. One could say that these two motives are driven by production needs. Other motives for capital expenditure can be classified more as opportunity driven. This means that capital expenditure can be very profitable, or relatively cheap, or both. The first aspect here focuses on demand and general economic conditions. Good prospects make investment more attractive. At the same time, businesses will use their cost of capital to evaluate their capital expenditure plans. The interest rate tends to play a prominent role in this assessment, as borrowing is usually part of the financing mix. Summarizing, the aim is to find indicators which reflect the underlying factors of capacity, demand, profitability and financing cost.

3.2 Correlation analysis

The next step in the selection process is identifying indicators which are connected to the fundamental factors mentioned above. Keeping the factors identified above in mind, several different types of indicators were selected. Indicators related to financial aspects of fixed capital formation are data on loans, interest rates, stock markets and residual income. The need to invest is represented by business survey data on capacity, combined with data on orders. Other indicators, such as exports and consumption but also competitiveness, represent demand developments which are indicative for the need and attractiveness of capital expenditure. Of course, quite few of these indicators represent general economic conditions, but as these are crucial to fixed capital formation as well. The indicators are shown in table 3.1 with the results of the correlation analysis, a more detailed description of the statistics used can be found in appendix I.

Table 3.1; potential indicators and their correlation with the growth rate of quarterly fixed capital formation (constant prices).

Indicator	*Level/ growth rate*	*Maximum correlation*	*Lag (minus is leading, plus is lagging)*	*Expected sign*	*Correlation at lag 0 (coincident)*
Business survey; Capacity utilization	level	**0.513**	4	+	0.321
Business survey; Capacity utilization	rate	**0.309**	0	+	0.309
Business survey; Assessment production capacity	level	**0.5**	-15	-	-0.376
Business survey; Assessment production capacity	rate	**-0.274**	-5	-	-0.237
Business survey; Assessment order inflow	level	**0.52**	1	+	0.504
Business survey; Assessment order inflow	rate	**0.245**	-7	+	0.151
Business survey; Assessment order book	level	**0.581**	3	+	0.456
Business survey; Assessment order book	rate	**0.289**	-6	+	0.227
Business survey; Assessment domestic competitiveness	level	**0.593**	1	+	0.548
Business survey; Assessment domestic competitiveness	rate	**0.398**	1	+	0.356
Business survey; Assessment EU competitiveness	level	**0.611**	2	+	0.386
Business survey; Assessment EU competitiveness	rate	**0.324**	2	+	0.173
National accounts; operating surplus	rate	**0.515**	3	+	0.295
Loans to private sector; short term	rate	**0.577**	8	+	0.369

Table 3.1 (continued); potential indicators and their correlation with the growth rate of quarterly fixed capital formation (constant prices).

Indicator	*Level/ growth rate*	*Maximum correlation*	*Lag (minus is leading, plus is lagging)*	*Expected sign*	*Correlation at lag 0 (coincident)*
Loans to private sector; medium term	rate	**0.216**	8	+	-0.151
Loans to private sector; long term	rate	**0.368**	1	+	0.363
Loans to private sector; all	rate	**0.486**	8	+	0.354
Loans to private and public sector; short term	rate	**0.551**	2	+	0.362
Loans to private and public sector; medium term	rate	**0.277**	8	+	-0.253
Loans to private and public sector; long term	rate	**0.609**	2	+	0.454
Loans to private and public sector; all	rate	**0.587**	2	+	0.377
Export of goods	rate	**0.357**	2	+	0.278
Industrial production	rate	**0.414**	2	+	0.371
Producer confidence	level	**0.6**	2	+	0.493
Producer confidence	rate	**0.299**	2	+	0.244
Real effective exchange rate	rate	**-0.44**	2	-	-0.365
Business confidence Germany	level	**0.41**	2	+	0.36
Business confidence Germany	rate	**0.244**	1	+	0.209
Eurozone business confidence	level	**0.385**	2	+	0.304
Eurozone business confidence	rate	**0.204**	2	+	0.159
EU manufacturing industry confidence	level	**0.415**	2	+	0.351
EU manufacturing industry confidence	rate	**0.186**	1	+	0.124

Table 3.1(continued); potential indicators and their correlation with the growth rate of quarterly fixed capital formation (constant prices).

Indicator	*Level/ growth rate*	*Maximum correlation*	*Lag (minus is leading, plus is lagging)*	*Expected sign*	*Correlation at lag 0 (coincident)*
Consumer confidence	level	**0.663**	3	+	0.483
Consumer confidence	rate	**0.5**	1	+	0.49
Household consumption	rate	**0.632**	4	+	0.432
Bankruptcies	rate	**-0.536**	-3	-	-0.496
Contract wages	rate	**-0.609**	-4	-	-0.411
Stock market	rate	**0.613**	1	+	0.546
Obligation yield, 1 year	level	**-0.277**	-3	-	-0.143
Obligation yield, 1 year	rate	**-0.467**	-13	-	0.24
Obligation yield, 10 years	level	**-0.154**	-3	-	-0.077
Obligation yield, 10 years	rate	**-0.308**	-13	-	0.112
yield curve	level	**0.437**	-5	+	0.195

Lags and leads in quarters

Very high correlations were not found, demonstrating the relatively discretionary nature of fixed capital formation. Between favourable conditions and actual capital expenditure lie the issues of deciding whether, how much, and when to invest. But all correlations were significant and quite a few are moderately high (around 0.6). The only case where the maximum correlation has a different sign than expected is for the assessment of production capacity, though even there the (lower) correlation at lag 0 has the right sign. More important, all underlying factors identified in the previous sector are represented by a number of the high-correlation indicators. This supports this studies analysis of relevant drivers for fixed capital formation, and indicates that it should be possible to construct a relevant and diverse conditions monitor. Business survey data on orders, capacity and competitiveness are strongly significant, as well as indicators of consumer demand. Export growth has a weaker correlation with capital formation, though confidence measures for the EU and Germany are moderately informative. As far as financial conditions are concerned, there are mixed results. Loans, developments on the stock market and the operating surplus (~profits) are highly correlated with fixed capital formation, but the link with interest rates is weaker. The development of contract wages exhibits a strong negative correlation. This might be due to its effect on profitability, or might be caused by business cycle effects.

It is notable that the growth rates of the sentiment indicators again have a longer lead than the corresponding levels. On the whole, there is a wide variety of leads and lags. A large number of indicators has maximum correlation within a two or three quarter band around fixed capital formation development, indicating a relatively tight link. Most slightly lag fixed capital formation, but only slightly. It is therefore probable that the coincident realisations still possess a strong link. Based on these results, a first selection was made, with the remaining indicators going through to the modelling stage. For the sentiment indicators, both the levels and growth rates were kept.

3.3 ARMA model testing

In this stage the indicators were tested for their significance in an ARMAX-model of fixed capital formation growth. This will show whether these indicators have a real connection with fixed capital formation, and at what lead or lag. Initially, the variables were be entered at the lag or lead of maximum correlation found in the previous stage. From this starting point, the lag or lead with maximum significance was sought. This is henceforth considered to be the relevant lead or lag for this indicator. Finally, the predictive power of the indicator was tested in a rolling regression, out-of-sample forecasting simulation. The forecasting error gives another measure by which to compare the importance of the different indicators.

First, it is necessary to formulate an ARMA-model for the relative year-on-year growth rate of fixed capital formation. The optimal formulation proved to be:

Capital formation=0.025+0.8*AR(1)-0.33*MA(1)+0.47*MA(2)-0.5*MA(4)
(0.1183) (0.000) (0.0000) (0.0040) (0.0030)

R^2=0.53, AIC=-3.48, out-of-sample forecast error = 3.6%-point, Q-stat 0.085, Jarque-Bera probability = 0.969, LM-test probability = 0.693

The model statistics show that this formulation performs satisfactorily.

In table 3.2, the results of the ARMAX-modelling are presented; some goodness-of-fit statistics, the out-of-sample forecast error, the lag or lead at which the indicator was most significant, and the estimated coefficient and its significance. Again, it is stressed that this exercise is not undertaken to forecast capital formation, but to test the strength of the link between the candidate indicators and capital formation development. Therefore, all test statistics are important and not just the forecast error.

Table 3.2; Significance of potential indicators in ARMAX model for fixed capital formation.

Indicator	R^2	*AIC*	*RMSE forecast (%-points)*	*Lag in model*	*Coefficient (significance)*
Business survey; Capacity utilization (level)	0.57	-3.53	**3.4%** (lag 0)	5	0.0092 (0.0138)
Business survey; Capacity utilization (rate)	0.604	-3.84	**3.5%**	-10	0.01397 (0.0225)
Business survey; Assessment production capacity (level)	0.708	-3.77	**3.5%**	-15	0.008 (0.0000)
Business survey; Assessment production capacity (rate)	ns				
Business survey; Assessment order inflow (level)	0.573	-3.57	3.6%	1	0.00475 (0.0011)
Business survey; Assessment order inflow (rate)	ns				
Business survey; Assessment order book (level)	0.656	-3.78	**3.1%** (lag 0)	1	0.00347 (0.0077)
Business survey; Assessment order book (rate)	ns				
Business survey; Assessment domestic competitiveness (level)	0.685	-3.73	**3%**	0	-0.00156 (0.00454)
Business survey; Assessment domestic competitiveness (rate)	ns				

Table 3.2 (continued); Significance of potential indicators in ARMAX model for fixed capital formation.

Indicator	R^2	*AIC*	*RMSE forecast (%-points)*	*Lag in model*	*Coefficient (significance)*
Business survey; Assessment EU competitiveness (level)	0.704	-3.83	**3.2%** (lag 0)	2	0.0033 (0.0039)
Business survey; Assessment EU competitiveness (rate)	0.775	-4.06	**3.4%** (lag 0)	3	0.0028 (0.0047)
National accounts; operating surplus	0.812	-4.16	(lag 0)	3	0.0049 (0.0003)
Loans to private sector; short term	0.602	-3.53	3.6% (lag 0)	8	0.0027 (0.0086)
Loans to private sector; all	0.583	-3.49	3.9% (lag 0)	8	0.0031 (0.0562)
Loans to private and public sector; short term	0.669	-3.73	3.7% (lag 0)	2	0.00289 (0.000)
Loans to private and public sector; long term	0.656	-3.7	3.7% (lag 0)	2	0.0067 (0.0000)
Loans to private and public sector; all	0.65	-3.68	3.9% (lag 0)	2	0.0036 (0.0000)
Export of goods	0.609	-3.49	**2.8%**	-5	0.434 (0.0016)
Industrial production	0.562	-3.54	**3.2%** (lag 0)	2	0.8011 (0.0063)
Producer confidence (level)	0.654	-3.75	3.8%	0	0.00579 (0.0168)
Producer confidence (rate)	ns				
Real effective exchange rate	0.562	-3.54	**2.7%** (lag 0)	3	-0.575 (0.0126)

Table 3.2 (continued); Significance of potential indicators in ARMAX model for fixed capital formation.

Indicator	R^2	*AIC*	*RMSE forecast (%-points)*	*Lag in model*	*Coefficient (significance)*
Business confidence Germany (level)	0.577	-3.58	**3.4%** (lag 0)	2	0.00197 (0.0016)
Business confidence Germany (rate)	ns				
EU manufacturing industry confidence (level)	0.57	-3.56	**3.2%** (lag 0)	2	0.0124 (0.0028)
EU manufacturing industry confidence (rate)	ns				
Consumer confidence (level)	0.667	-3.81	**3.2%** (lag 0)	3	0.0022 (0.000)
Consumer confidence (rate)	0.583	-3.55	**3.0%**	-1	0.0018 (0.0022)
Household consumption	0.713	-3.95	**2.7%** (lag 0)	4	2.306 (0.0000)
Bankruptcies	0.557	-3.47	3.8%	-3	-0.001 (0.0157)
Contract wages	0.646	-3.6	3.6%	-3	-0.0369 (0.0002)
Stock market	0.689	-3.86	**3.0%**	0	0.0019 (0.000)
Obligation yield, 1 year	0.602	-3.48	4.5%	-13	-0.017 (0.046)
Obligation yield, 10 years	ns				
yield curve	0.59	-3.52	3.8%	-5	0.034 (0.0009)

Forecast errors smaller than forecast error (3.6%-points) benchmark ARMA-model are shown in bold. Forecast errors for lagging indicators have been calculated at lag 0.

The value of the coefficient cannot be translated into the strength of the link as the indicators were not standardized. Quite a few indicators were found to be not significant in the ARMAX-model, though in several cases it concerns growth rates of sentiment indicators, of which the level is significant. The coefficients of the domestic competitiveness and capacity assessment indicators have the wrong sign,

which poses a problem. Several indicators strongly reduce the forecasting error, such as consumption, exports, stock market performance, the real effective exchange rate, and competitiveness. These indicators are mainly connected to demand developments, giving an indication of the main driver for fixed capital formation. This does not mean that these are the indicators best indicators analyzing the conditions for fixed capital formation. As mentioned, the goal is not to model or forecast, but to identify indicators which represent the underlying factors set out before, and which have proven strong links with fixed capital formation. Several other selection criteria are used as well, such as maximum correlation, correlation at lag 0 and volatility. Using these criteria, in the final selection stage, several indicator sets were evaluated as a whole. This means that the overall stance of the indicator set should reflect fixed capital formation conditions, but it should also be possible to analysing underlying trends from the indicator set.

3.4 Analysis of aggregate performance

Given the considerations and results in the previous sections, different argumentations are possible to select or deselect indicators and to construct sets. Several indicators were dropped because of practical or theoretical reasons. For example, the operating surplus (~profits) is difficult to include as it is published with a considerable lag. In contrast, contract wages development is not very suited as an indicator as the reason for its negative influence is ambiguous, and therefore difficult to use for analytical purposes. On the other hand, indicators can also be included despite of their relatively weak quantitative relation with fixed capital formation, because the content of their information is very relevant.

Three different approaches to constructing a set of indicators for monitoring conditions were tested here. Two are rather straightforward, the final one is somewhat more sophisticated.

① Use the indicators with the lowest forecast error.

② Use the indicators with the highest correlation at lag 0.

③ Use indicators which combine high correlations with low forecasting errors., but which also explicitly reflect important aspects of capital formation as identified in the underlying factors.

It is important to keep in mind that this stage does not yet concern the construction of the monitoring system itself. This is still the stage of indicator selection, which is a separate issue. What system or method is to be used to communicate the information contained in the selected indicators is a development issue in itself, which will be addressed in the final section of this paper. The performance of the indicators sets as a whole is analyzed in two different ways which summarize what the overall message of the conditions monitor would be at every point in time.

The first method for assessing the overall message of the monitoring set is by simply taking the average of all indicators. This average approximates the overall impression the monitor would give of the conditions at each point in time. Thus, this summarization can be compared to the actual fixed capital formation development realisations, to assess how well the monitor functions. In order for this to be possible, the indicators do need to be standardized according to:

$$\text{Standardized value}_t = (\text{original value}_t\text{-average})/(\text{standard deviation})$$

This ensures that all indicators have roughly the same minimum and maximum value, and average zero, and can thus be shown on equal terms.

A different method for evaluating the joint development of the selected indicators is by using factor analysis. This technique is based on the extraction of common components or factors from groups of variables. It seeks to describe complex dataset by identifying relatively few underlying factors, which together can explain the observed behaviour. Usually, many factors can be extracted, but they differ in importance. The first factor, or principal component, extracted is the most important one, and will in a coherent indicator set explain a significant part of the behaviour of the individual series. How important a factor is, is measured by the percentage of the total variance of the series it explains.

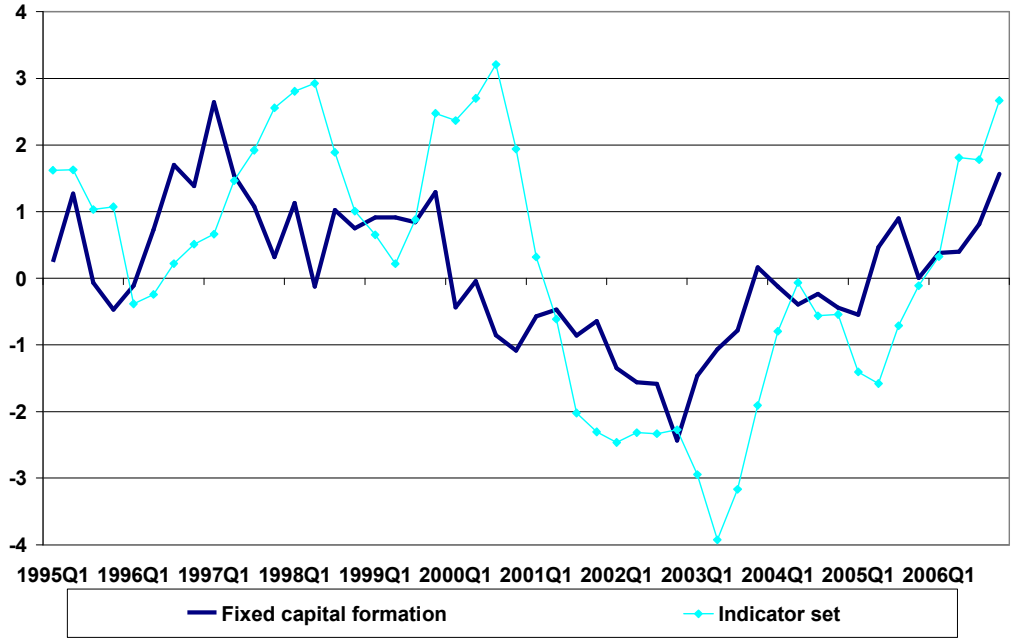
The hypothesis here is that the most important component will be related to fixed capital formation development, as the first principal component is supposed to measure that what the individual series have most in common. As these indicators have been based on the strength of their relationship with fixed capital formation, it is likely that this represents their strongest common component. As said, the percentage of total variance explained indicates how strong the communality is. Another measure of this are the factor loadings. These indicate how each individual indicator is related to the common component. High factor loadings mean a strong link. Therefore, if all or most individual indicators have a high factor loading on the common component, this means both that the indicators have much in common and that the common component gives a good representation of the indicator set as a whole.

The first candidate indicator set consists of the indicators which enabled a clear reduction in forecast error when included in the ARMAX-model. This criterion was met by the following indicators:

- **Stock market performance**
- **Household consumption**
- **Business survey; domestic competitiveness**
- **Consumer confidence**
- **Exports**
- **Business survey; Order book**
- **EU manufacturing industry confidence**
- **Industrial production**
- **Reel effective exchange rate**

These indicators were standardized and their common development computed, both by taking the simple average and by principal component analysis. The indicators were not shifted in time, and the level of the sentiment indicators was used. The factor analysis gave good results, with the first principal component explaining 62% of total variance, and all indicators possessing similar loadings on the first principal component This indicates a clear common factor and that no one indicator dominates. But despite these good results, a serious problem was found. The development of the indicator set as a whole, as represented by the average development seriously lags the development of fixed capital formation, see graph 3.1.

Graph 3.1; Simple average of standardized indicator set 1 (minimum forecast error) compared with standardized growth rate of fixed capital formation (constant prices).



It is clearly visible that the aggregate development of the monitoring set accurately tracks even relatively minor periods of stronger and weaker fixed capital formation, but with a distinct lag. This is reflected in the results of a correlation analysis of these two series. Correlation is strong at 0.76, but the monitoring set lags three quarters on average. This means that this indicator set is unsuitable for use in current business cycle analysis, though the identification of the relationship between these indicators and fixed capital formation remains interesting.

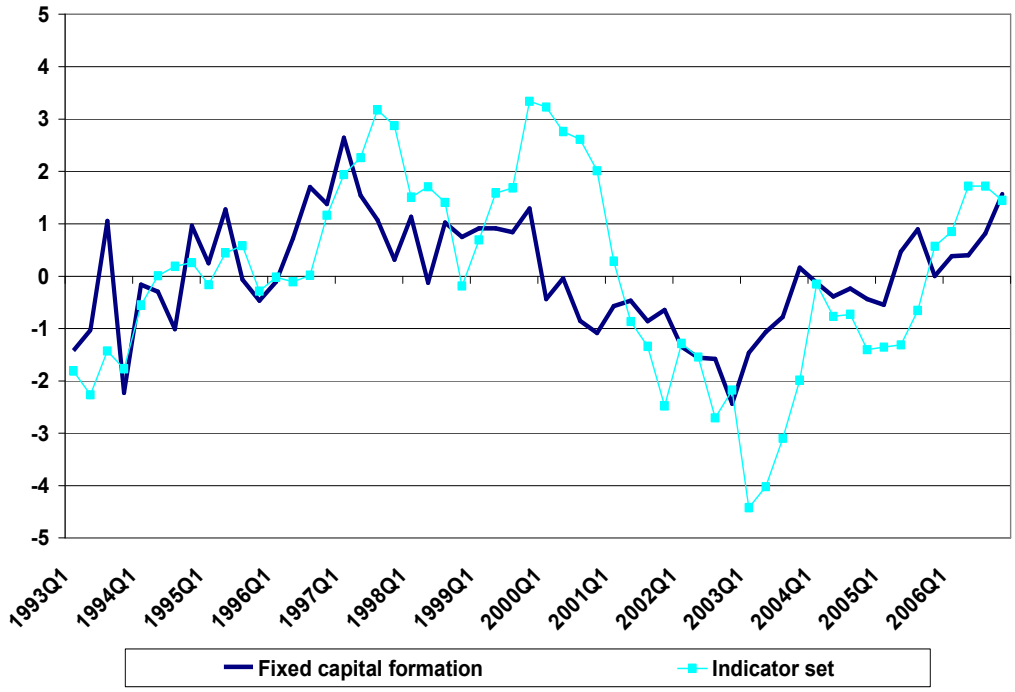
The next option is to use the indicators which have a high coincident correlation with the growth rate of fixed capital formation. This choice has two advantages; a high correlation means that the normal form of the indicator has a strong coherence with the target indicator, and a strong coincident relationships means that in

publication current values can be used. The indicators selected using this criterion were:

- **Stock market performance**
- **Consumer confidence**
- **Bankruptcies**
- **Business survey; order inflow**
- **long-term loans to the private and public sector**
- **Producer confidence**

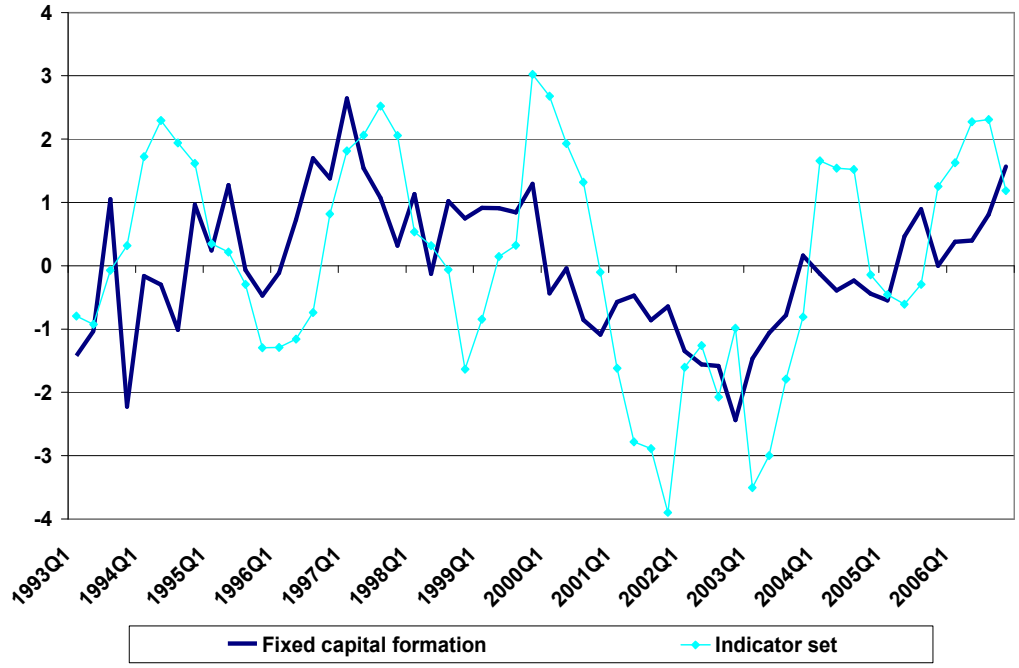
Unfortunately, the results for this monitoring set resemble those of the previous one. Principal components analysis again indicates clear and balanced coherence, with the first principal component explaining 61% of total variance, with similar loading factors for all indicators. But again, aggregate development lags that of fixed capital formation, by two quarters according to the correlation analysis.

Graph 3.2; Simple average of standardized indicator set 2 (maximum correlation) compared with standardized growth rate of fixed capital formation (constant prices).



A possible solution to this time lag is present in the fact that half the indicators in this set are sentiment indicators. The results show that year on year changes in the sentiment indicators have a longer lead than the levels. This means that by including the sentiment indicators in the form of changes in stead of levels should decrease the aggregate lag of the set. Correlation analysis shows that this is the case, reduce the lag to an acceptable one quarter, but unfortunately the correlation is reduced to 0.61 as well (from 0.72). Graph 3.3 shows that in this form the resemblance between the aggregate development of the indicator set and that of fixed capital formation is diminished.

Graph 3.3; Simple average of standardized indicator set 2 (maximum correlation, sentiment indicators as year on year changes) compared with standardized growth rate of fixed capital formation (constant prices).



Apart from these problems of timing, these two monitoring sets suffer from a more fundamental problem. As stated, the aim of this exercise is to construct a tool for analysing relevant developments concerning fixed capital formation. This is reflected in the underlying factors defined in section 3.1. This was not part of the considerations in selecting the first two candidate indicator sets. The final set was constructed using a more balanced approach where the goal was explicitly to find indicators relating to demand, capacity and financial factors. This resulted in the following selection:

Financial:

- **Stock market performance**
- **Yield on 1 year obligations**
- **long-term loans to the private and public sector**

Demand:

- **Consumer confidence**
- **Exports**
- **Business confidence Germany**

Capacity:

- **Business survey; order inflow**
- **Business survey; Capacity Utilization**

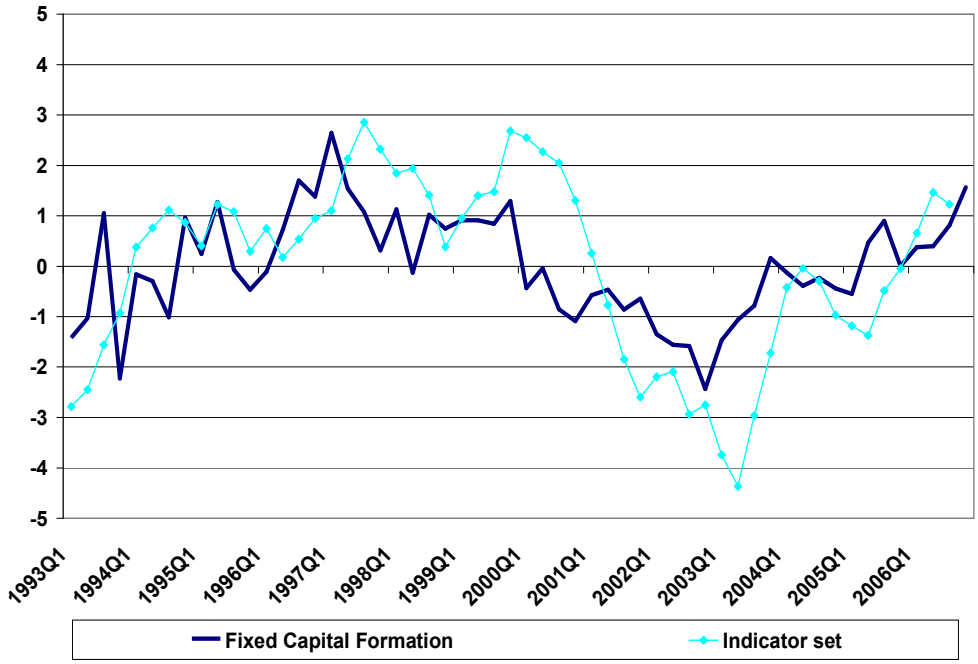
This balanced is more informative as far as conditions for fixed capital formation are concerned. There is somewhat more diversity between the indicators compared to the previous set, as the results from the factor analysis show.

Table 3.3; Results of factor analysis for indicator set 3.

First principal component	*Indicator set*
	*Total variance explained:**49 %***
Indicator	*Factor loading*
Stock market performance	0.355
Yield on 1 year obligations	-0.051
long-term loans to the private and public sector	0.267
Consumer confidence	0.422
Exports	0.358
Business confidence Germany	0.396
Business survey; order inflow	0.436
Business survey; Capacity Utilization	0.383

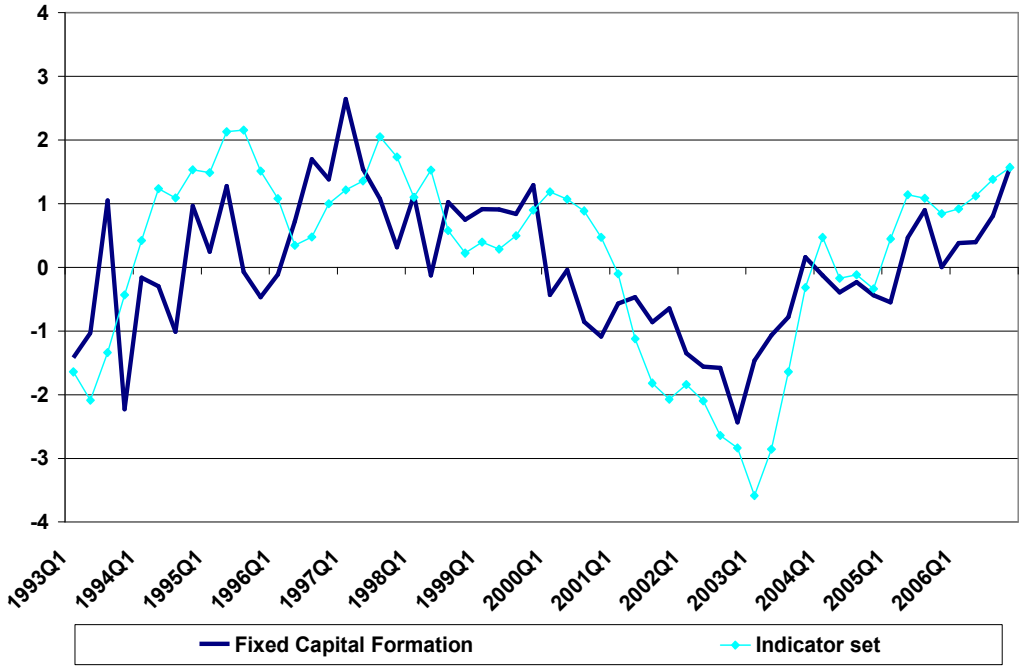
The fraction of total variance explained by the first principal component is relatively low at 49%, and there is more variation in the size of the loading factors. But as mentioned, for this selection some coherence has been sacrificed to increase the information content of the indicator set. Even so, the overall coherence has not really suffered, as correlation analysis puts this at 0.70, though again with a lag of two quarters.

Graph 3.4; Simple average of standardized indicator set 3 (balanced set) compared with standardized growth rate of fixed capital formation (constant prices).



The overall pattern of the indicator set average is quite similar to that of fixed capital formation development. It is somewhat more smooth, while still containing relevant medium term developments. This means that the monitoring set will be able to assist in distinguishing between random and more substantial developments as well as shining light on the underlying developments influencing fixed capital formation. Unfortunately, the indicator set again clearly lags the target indicator. But as this set again contains several sentiment indicators, it is possible to decrease the lag by switching to year on year changes. After doing this, the coherence between the indicator set and fixed capital formation was increased by entering the leading indicators shifted in time to maximise coherence (see table 3.4). It takes somewhat more effort to "read" the resulting monitoring set, but performance is greatly enhanced by these operations, as can be seen in graph 3.5.

Graph 3.5; Simple average of standardized indicator set 3 (balanced set, leading indicators shifted and sentiment indicators as year on year changes) compared with standardized growth rate of fixed capital formation (constant prices).



The graph shows that especially from 2000 onwards this formulation of the indicator set tracks fixed capital formation much more closely, though still not perfectly. Correlation over the whole period is 0.64, still with a two quarter lag. But from 2000 onwards, correlation is 0.78 and the lag has disappeared. Factor analysis shows that this set is reasonably balanced with a few indicators possessing relatively low factor loadings. The fraction of variance explained is rather low though.

In general, the coherence between fixed capital formation development and the monitoring indicator sets is lower than between the monitoring indicators for exports and consumption. In those cases, average development of the indicator set was virtually coincident with that of the target indicator. But on the whole this indicator set achieves all the required objectives. Periods of weaker and stronger fixed capital formation are correctly identified, even though this is not always the case for the actual peaks and troughs. And of course the composition of this particular indicator set is designed to give information on aspects crucial for the analysis of the development of fixed capital formation.

Table 3.4; Results of factor analysis for indicator set 3 with shifted leading indicators and sentiment indicators as year on year changes.

First principal component		*Indicator set*
		Total variance explained:27 %
Indicator	*Time shift (quarters)*	*Factor loading*
Stock market performance	-	0.402
Yield on 1 year obligations	3	-0.248
long-term loans to the private and public sector	-	0.413
Consumer confidence	-	0.426
Exports	3	0.448
Business confidence Germany	-	0.132
Business survey; order inflow	4	0.385
Business survey; Capacity Utilization	5	0.244

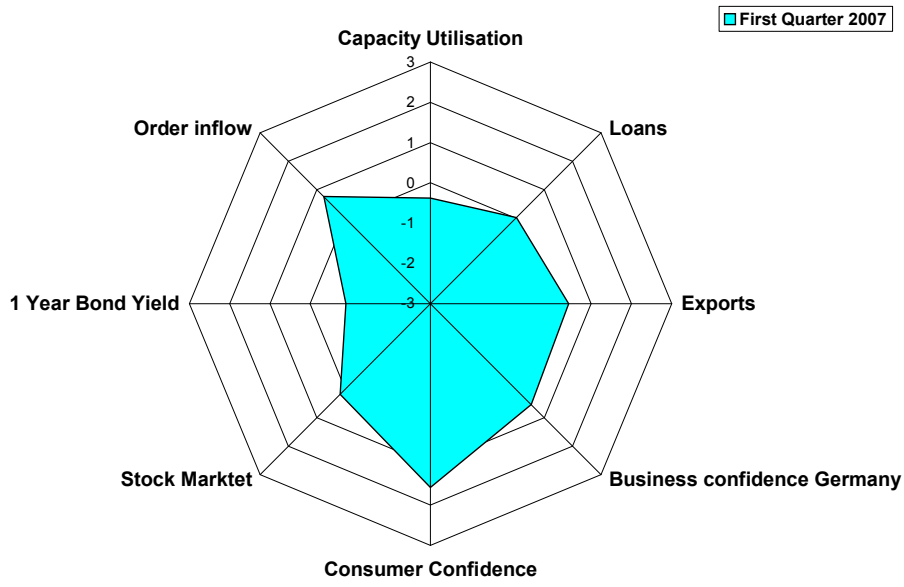
As far as accuracy is concerned, this last version where the sentiment indicators are in the form of year on year changes, and the leading indicators are shifted forward, is to be preferred. This set will therefore be used in the construction of the actual monitoring system in the final section of this study. The disadvantage of using the indicators in this form is of course that it deviates from the way in which the statistics are published by Statistics Netherlands. The connection with the standard publication of short term economic statistics will be weaker. Therefore one could also chose to use the previous formulation of this final indicator set, using only current values of the indicators and in their published format, though this will diminish the power of the monitoring system somewhat.

All these results are mainly relevant for the indicator selection. The common indicators computed in this section are not meant for publication, and are not in any way the final goal. On the contrary, it is best to show the development of the related indicators individually, as then they yield the most information. How this is to be done is the next step, the design of the actual monitoring system itself. This is the subject of the next section.

4. A graphic conditions monitor

The most important aspect of the monitoring system is that it should be able to transfer in simple and easily comprehensible manner information on developments relevant for fixed capital formation. Its very structure should make available implicit knowledge on underlying factors which influence fixed capital formation. This might sound somewhat abstract, but its leads to a surprisingly simple practical form. The indicators selected above should be shown individually, thus indicating by their presence what kind of factors are relevant for fixed capital formation. Furthermore, the monitoring system should be graphic, as this means that it will be quick and easy to read and interpret. It should be constructed in such a manner that the overall picture represents the "strength" of the fixed capital formation conditions. For these reasons I propose using the spider-diagram, see graph 4.1.

Graph 4.1; Proposed graphic conditions monitor for fixed capital formation.

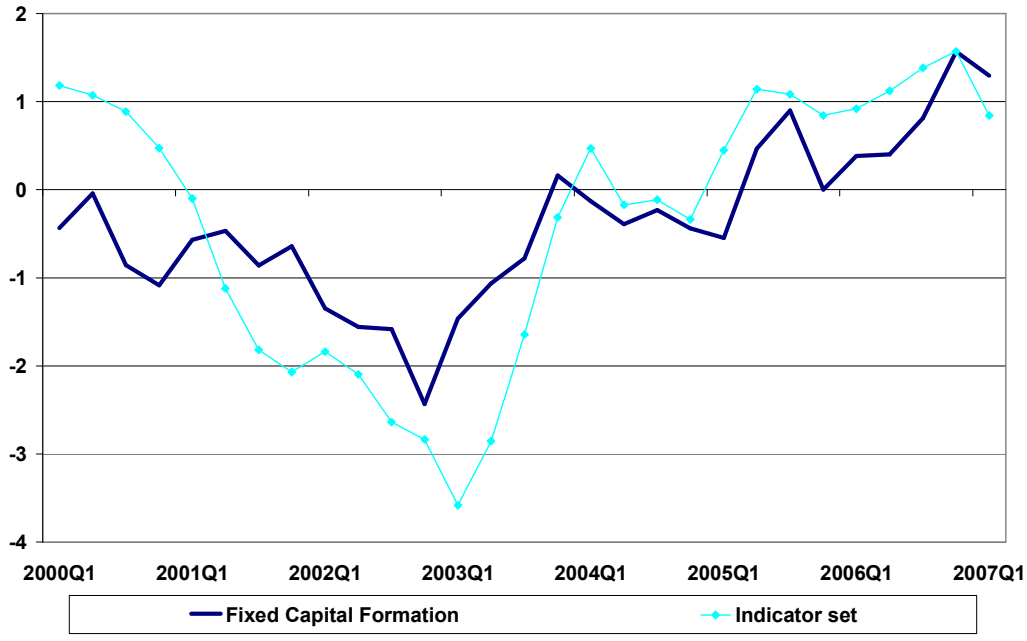


This functions well for two main reasons; the surface covered is a direct and easily interpreted measure of the current level of conditions. And it is quite clear that the whole is constructed from individual indicators, which can be immediately identified and analysed separately. The values of the indicators are entered in a standardized fashion, as described in section 3 (the 1-year bond yield has been inverted). This allows them to be shown in one figure at the same scale. Other methods for weighing the data are possible, but this one is the most straightforward. Though it might be worth considering using an approach which amplifies the

developments in the related indicators in order to achieve greater clarity As mentioned before, this indicator set is only a proposal. Using less indicators or making all or some of these optional is a distinct possibility.

In diagram 4.1 the situation in the first quarter of 2007 is shown, when the realisation of the growth rate of fixed capital formation was +10.1% year-on-year. This is an interesting point in time to consider the performance of the monitoring system. Because although the overall stance of the monitor is positive, it is somewhat weakly so, while 10.1% growth is not a weak realisation. Graph 4.2 might give an explanation. It shows that conditions have weakened considerably going from 2006Q4 to 2007Q1. But this reflects the development in the growth rate of fixed capital formation, as this seems to have peaked in 2006Q4 at 11.7% year on year. So even though conditions seem to be somewhat weak given the strength of the realisations, the development in conditions does match the development in realisations.

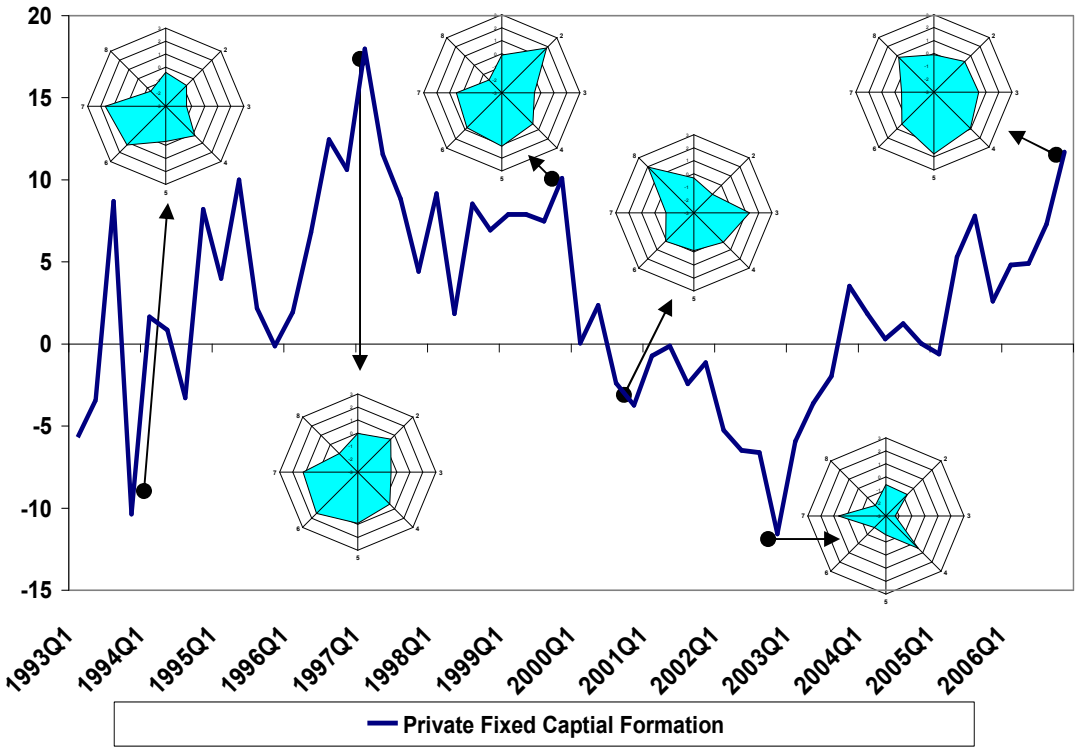
Graph 4.2; Simple average of standardized indicator set 3 (balanced set, leading indicators shifted and sentiment indicators as year on year changes) compared with standardized growth rate of fixed capital formation (constant prices).



This weakening of conditions indicates that the observed slowing of fixed capital formation growth probably is no accident. A more detailed analysis of indicator development supports this. Demand conditions are still overall positive, with orders and consumer confidence developing above average. But exports and German business confidence are neutral, and the same goes for financial conditions as given by loans and the stock market. Capacity utilisation and the interest rate are contributing negatively. The conclusion is that while conditions are overall still positive for fixed capital formation, a detailed analysis gives a more unfavourable

picture. Support for fixed capital formation is uneven, with several indicators weakening. For further evaluation, the monitor diagram can be compared in graph 4.3 to the realisations at several other moments in time.

Graph 4.3; Evolution in time of Proposed graphic conditions monitor, compared with corresponding realisations of the growth rate of private fixed capital formation.



Graph 4.3 shows how the monitor diagram contracts and expands as fixed capital formation development is weaker or stronger, as it was designed to do. At any one time one or two indicators can exhibit deviant behaviour, but this is not a problem as one indicator can not disturb the overall picture. The performance of the monitor is somewhat less than in the monitors for exports and consumption, reflecting the more discretionary nature of capital expenditure. The incidental deviations of individual indicators are more serious, and the link between the area of the monitor diagram and the strength of fixed capital formation development is less tight. But when considered over the medium term, there is good correspondence between phases of weaker and stronger fixed capital formation growth and respectively the contractions and expansions of the monitor diagram.

Graph 4.2 also points to interesting animation possibilities. A obvious option is to add a time function to the diagram, allowing the development of the factors and the diagram as a whole to be tracked in time. For full effect it should be combined with a corresponding concurrent diagram showing the evolution of the development of fixed capital formation.

Appendix I; Data description

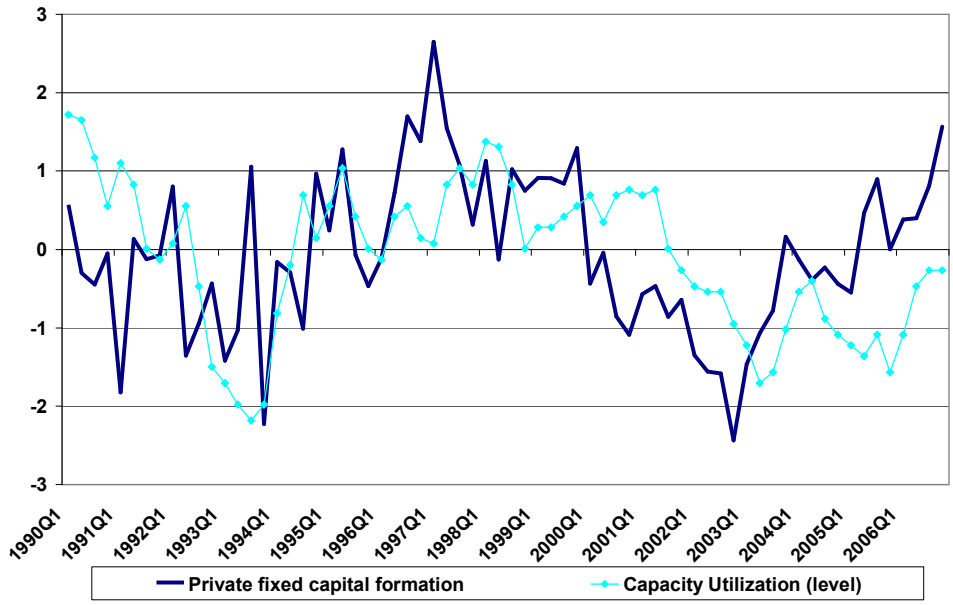
Indicator	*Level/ growth rate*	
Business survey; Capacity utilization	level	Percentage of production capacity currently utilised (Statistics Netherlands)
Business survey; Capacity utilization	rate	$Realisation_t$-$realisation_{t-4}$
Business survey; Assessment production capacity	level	Assessment of available production capacity (Statistics Netherlands)
Business survey; Assessment production capacity	rate	$Realisation_t$-$realisation_{t-4}$
Business survey; Assessment order inflow	level	Assessment of the inflow of new orders (Statistics Netherlands)
Business survey; Assessment order inflow	rate	$Realisation_t$-$realisation_{t-4}$
Business survey; Assessment order book	level	Assessment of the total order book (Statistics Netherlands)
Business survey; Assessment order book	rate	$Realisation_t$-$realisation_{t-4}$
Business survey; Assessment domestic competitiveness	level	Development of competitiveness on the domestic market (Statistics Netherlands)
Business survey; Assessment domestic competitiveness	rate	$Realisation_t$-$realisation_{t-4}$
Business survey; Assessment EU competitiveness	level	Development of competitiveness on the EU market (Statistics Netherlands)
Business survey; Assessment EU competitiveness	rate	$Realisation_t$-$realisation_{t-4}$
National accounts; surplus income	rate	From National Accounts; income from assets and business exploitation (Value added minus wages and depreciation) (Statistics Netherlands)
Loans to private sector; short term	rate	Loans made by financial institutions in the Netherlands to private sector institutions, duration < 1 year (DNB)

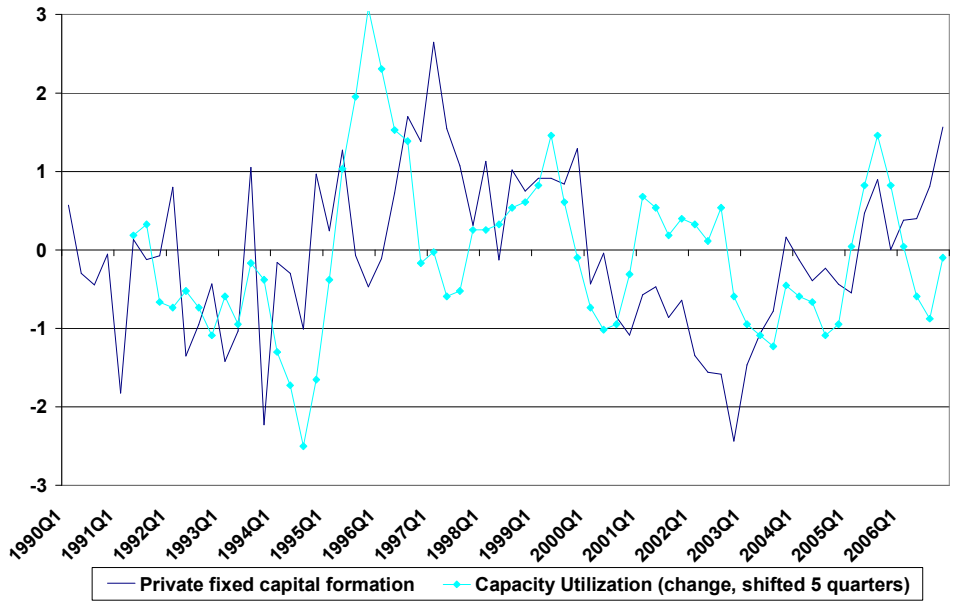
Loans to private sector; medium term	rate	Loans made by financial institutions in the Netherlands to private sector institutions, duration 1-5 years (DNB)
Loans to private sector; long term	rate	Loans made by financial institutions in the Netherlands to private sector institutions, duration >5 years (DNB)
Loans to private sector; all	rate	Loans made by financial institutions in the Netherlands to private sector institutions, all durations (DNB)
Loans to private and public sector; short term	rate	Loans made by financial institutions in the Netherlands to private and public sector institutions, duration < 1 year (DNB)
Loans to private and public sector; medium term	rate	Loans made by financial institutions in the Netherlands to private and public sector institutions, duration 1-5 years (DNB)
Loans to private and public sector; long term	rate	Loans made by financial institutions in the Netherlands to private and public sector institutions, duration >5 years (DNB)
Loans to private and public sector; all	rate	Loans made by financial institutions in the Netherlands to private and public sector institutions, all durations (DNB)
Export of goods	rate	Monthly volume-index of the export of goods (Statistics Netherlands)
Industrial production	rate	Monthly volume-index of industrial production (Statistics Netherlands)
Producer confidence	level	Composite indicator of industry producer confidence (Statistics Netherlands)
Producer confidence	rate	$Realisation_t$-$realisation_{t-4}$
Real effective exchange rate	rate	Trade weighted exchange rate, corrected for inflation differences (OECD)
Business confidence Germany	level	Germany OECD CLI Business climate indicator
Business confidence Germany	rate	$Realisation_t$-$realisation_{t-4}$
Eurozone business confidence	level	Euro zone industrial confidence indicator Eurostat
Eurozone business confidence	rate	$Realisation_t$-$realisation_{t-4}$
EU manufacturing industry confidence	level	E15 Manufacturing - Industrial confidence indicator (OECD)
EU manufacturing industry confidence	rate	$Realisation_t$-$realisation_{t-4}$
Consumer confidence	level	Composite indicator of consumer confidence (Statistics Netherlands)

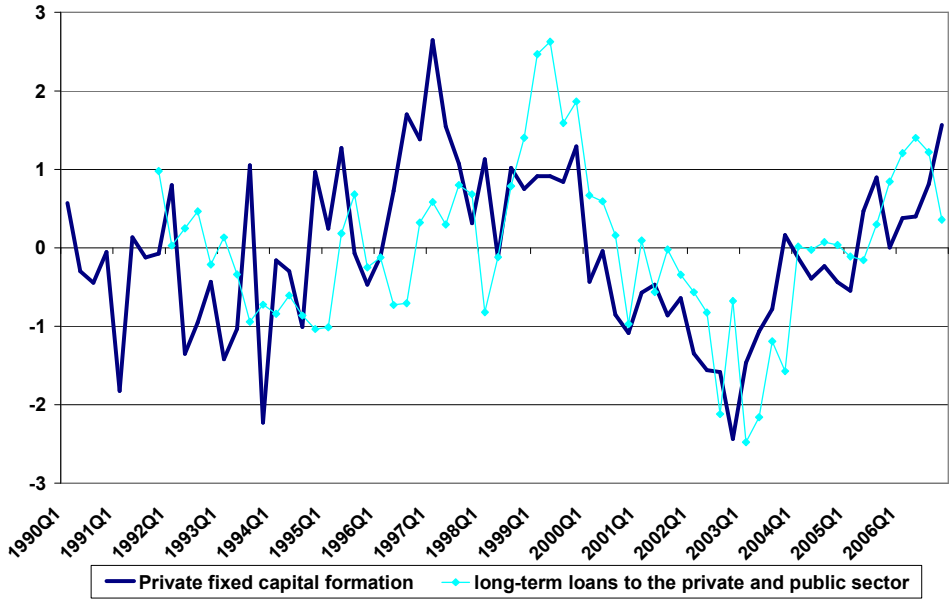
Consumer confidence	rate	$Realisation_t$-$realisation_{t-4}$
Household consumption	rate	Monthly volume index of household consumption (Statistics Netherlands)
Bankruptcies	rate	Number of bankruptcies, excluding one-man businesses (Statistics Netherlands)
Contract wages	rate	Development of monthly wages according to index of average collective bargaining contract wages (Statistics Netherlands)
Stock market	rate	Composite index of Dutch stock market (OECD)
Obligation yield, 1 year	level	Yield on 1 year government bonds (DNB)
Obligation yield, 1 year	rate	$Realisation_t$-$realisation_{t-4}$
Obligation yield, 10 years	level	Yield on ten year government bonds (DNB)
Obligation yield, 10 years	rate	$Realisation_t$-$realisation_{t-4}$
yield curve	rate	Yield on ten year government bonds minus yield on one year government bonds

Appendix II; Graph of indicators and private fixed capital formation

All indicators standardized, sentiment indicators in levels and year on year changes, others in growth rates. Change in the 1-year bond yield is inverted.



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Private fixed capital formation
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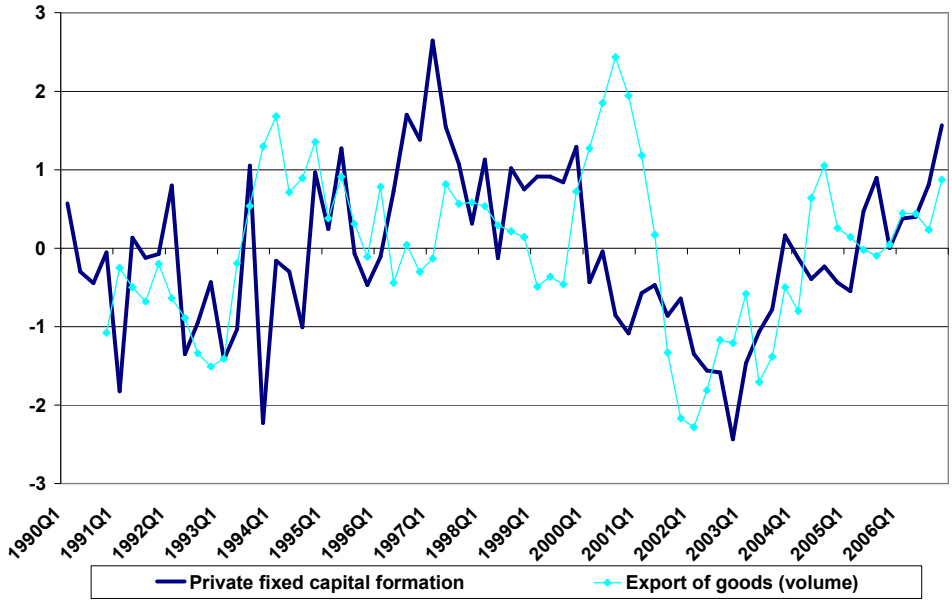
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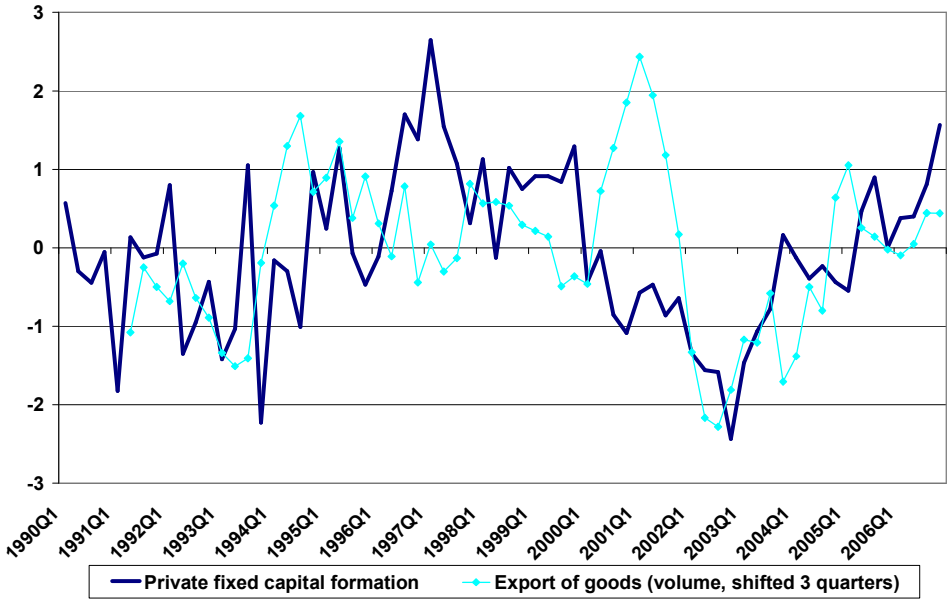
Private fixed capital formation
Export of goods (volume)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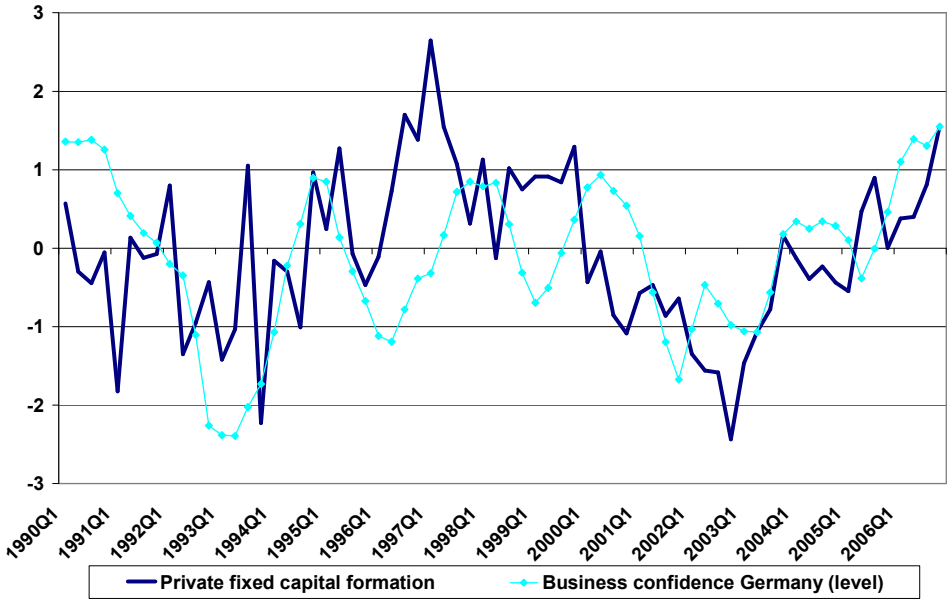
Private fixed capital formation
Export of goods (volume, shifted 3 quarters)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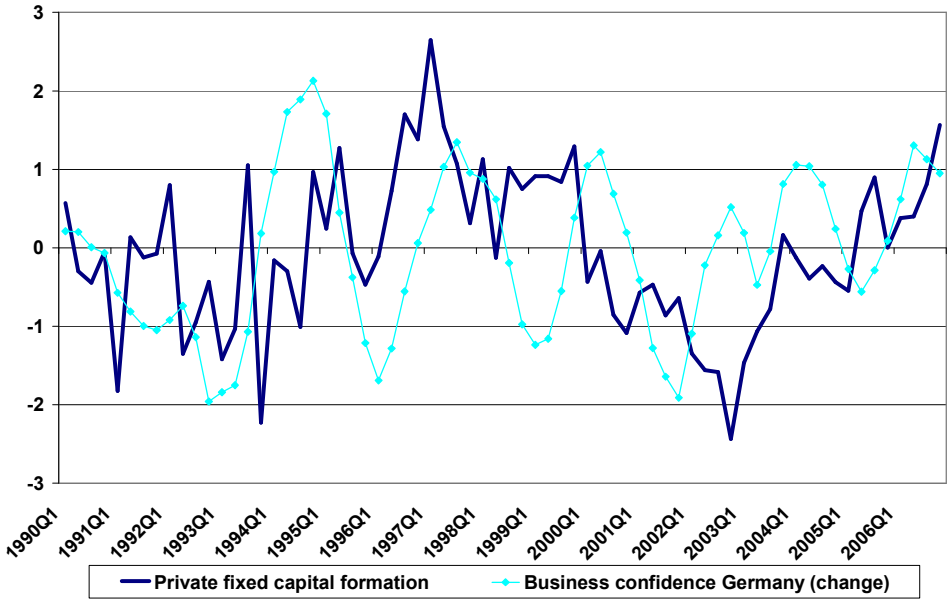
Private fixed capital formation
Business confidence Germany (level)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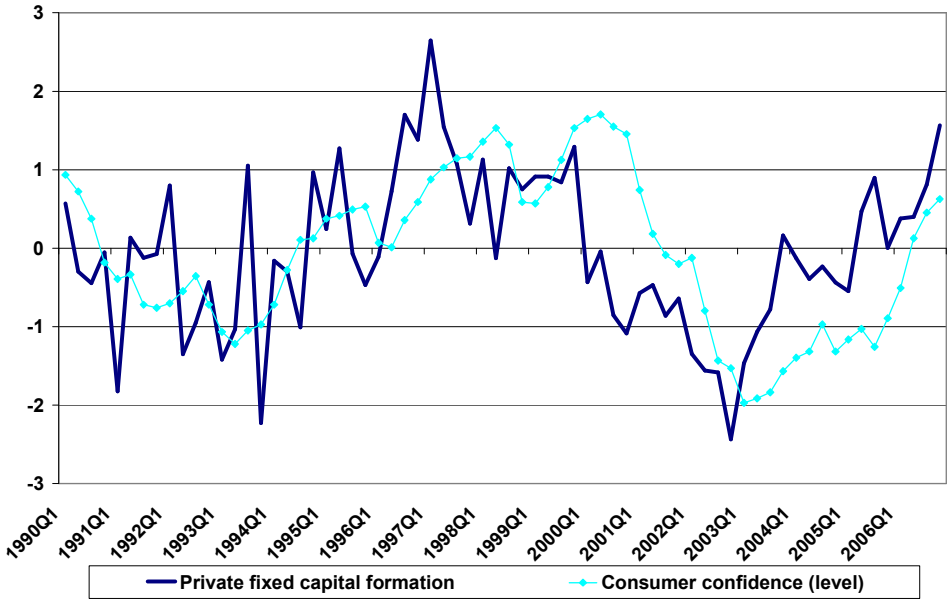
Private fixed capital formation
Business confidence Germany (change)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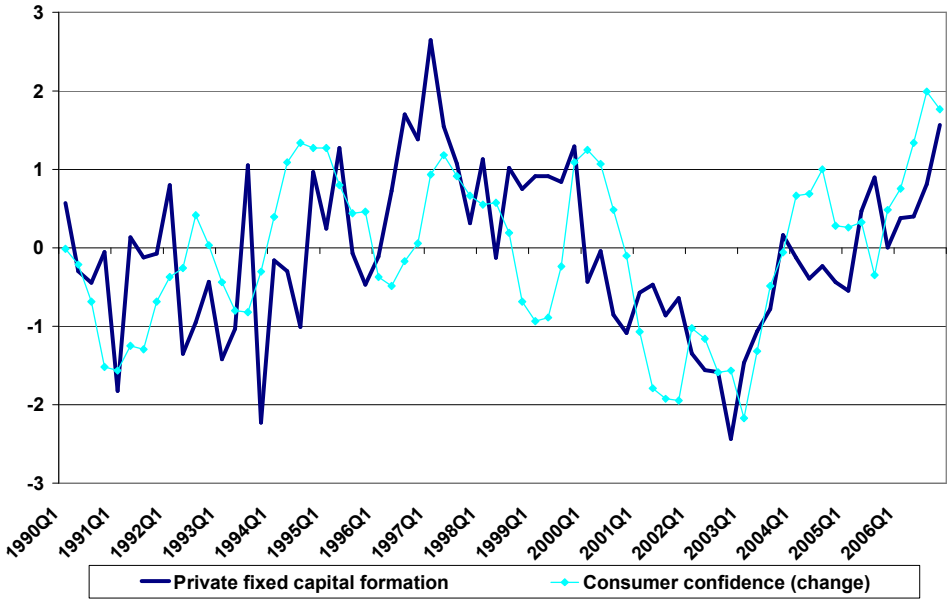
Private fixed capital formation
Consumer confidence (level)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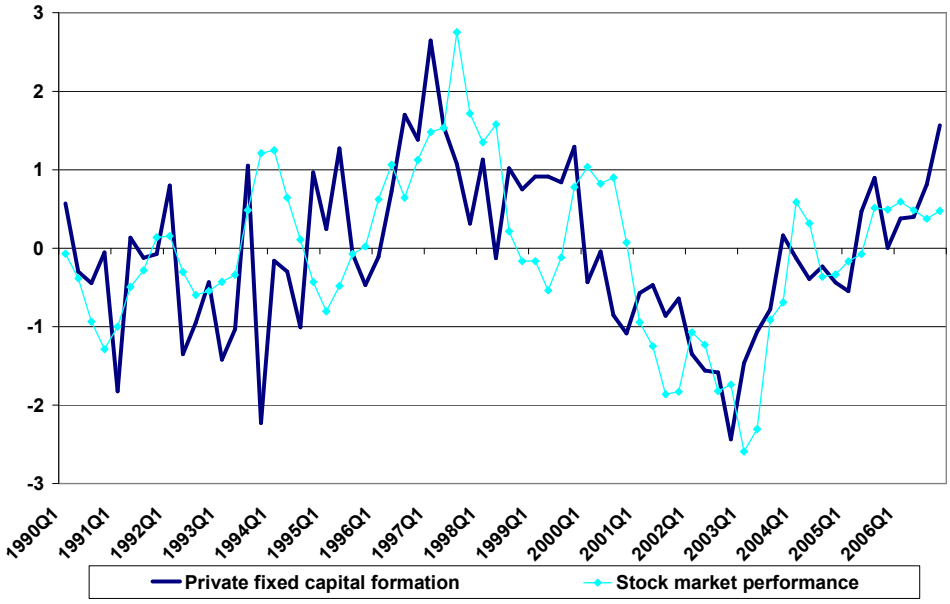
Private fixed capital formation
Consumer confidence (change)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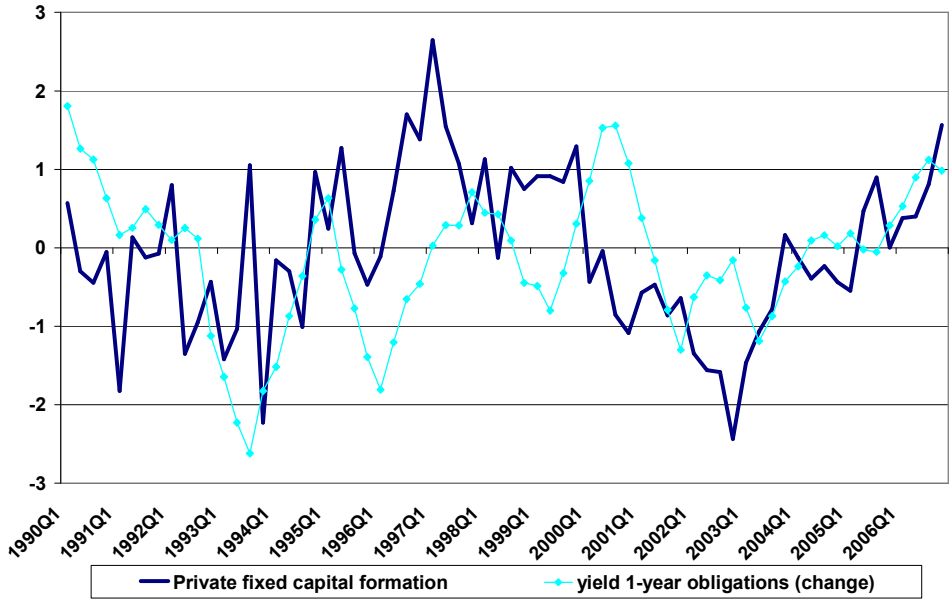
Private fixed capital formation
Stock market performance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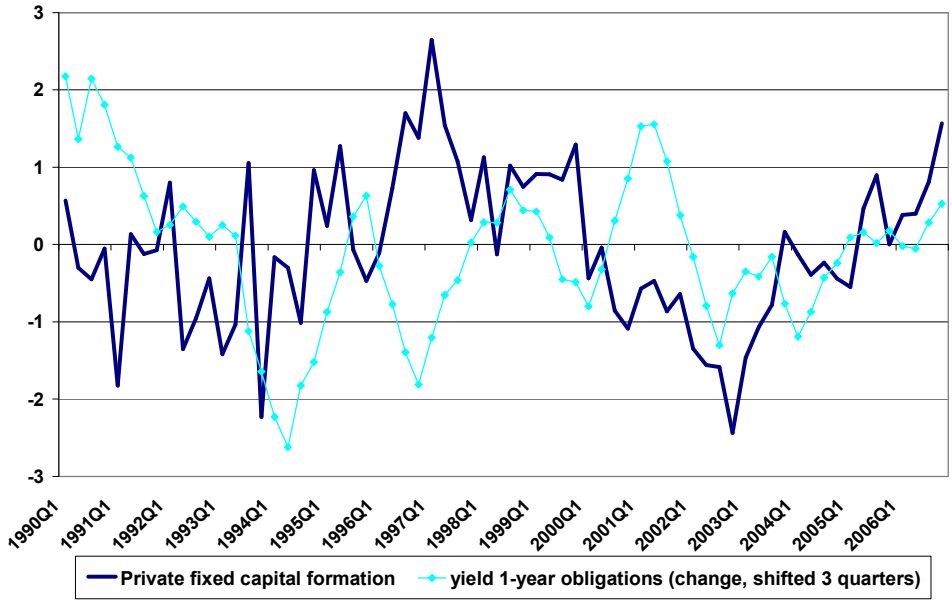
Private fixed capital formation
yield 1-year obligations (change)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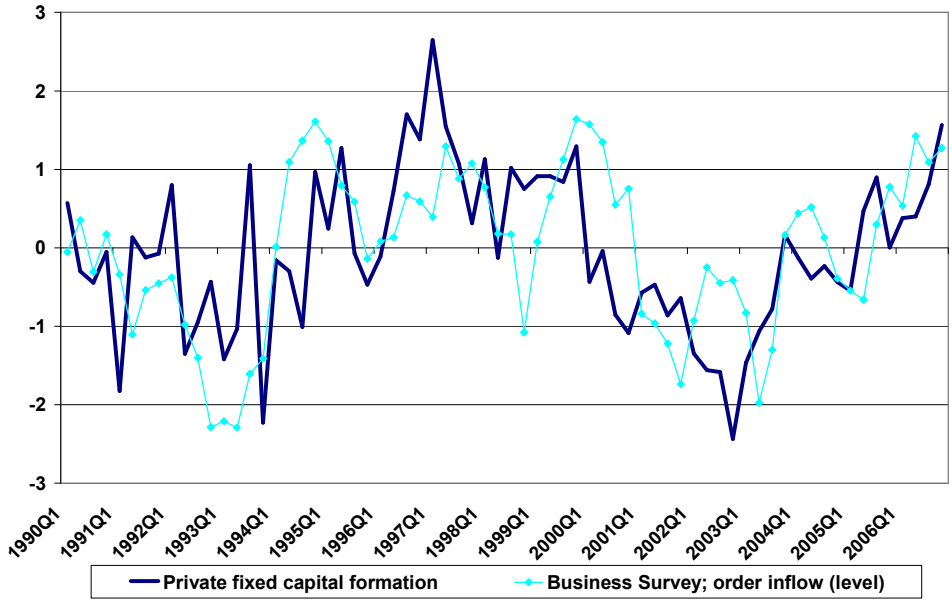
Private fixed capital formation
yield 1-year obligations (change, shifted 3 quarters)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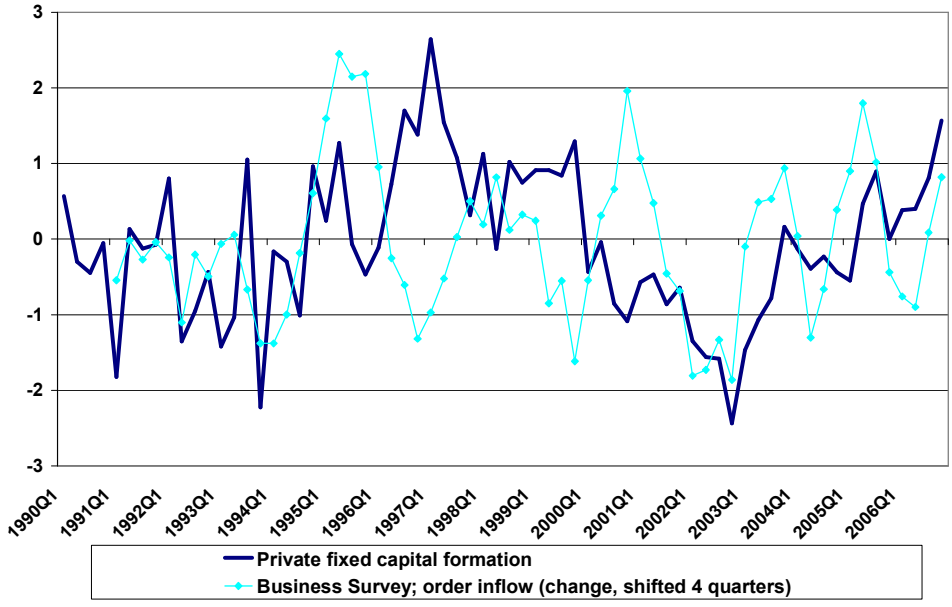
Private fixed capital formation
Business Survey; order inflow (level)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Private fixed capital formation
Business Survey; order inflow (change, shifted 4 quarters)