Discussion paper

Relationships between inflation indicators

Sara Houweling
Kees Zeelenberg

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Content

Summary

In 2017 Statistic Netherlands released the Price Dashboard, consisting of seventeen indicators related to inflation. We investigated the temporal relationships between the inflation indicators, based on historical time series. We found that most of the indicators are related to other indicators within the dashboard, but only to a certain extent. There is very little correlation between the price of gold and AEX share prices with other indicators. The highest correlations were found between CPI energy and import price of crude oil and between wages and CPI services. We identified which indicators are leading and lagging for other indicators and determined the associated lag. Further we found that predicting CPI turning points using other indicators from the dashboard as leading indicator could be possible, though with varying lead times and precision.

Keywords

Inflation, Price dashboard, Consumer Price Index

1. Introduction[1]

What is inflation? Statistics Netherlands has made a rigorous shift last year in the answer to this simple question. To explain the reason for this shift, we take a closer look at inflation. Most measures of inflation consider a basket of consumer goods and measure price changes within this basket. So did Statistics Netherlands and the result was published as 'the inflation of February 2017 was 1.8%'. Recently this strategy was revised to acknowledge that price changes in consumer goods are not the only element of inflation. For example, price changes in consumer goods are very different from price changes in houses, which can be considered as part of inflation as well (Kazemier, Zeelenberg and Walschots, 2017). Therefore Statistics Netherlands created the price dashboard in which price changes are shown from a broader perspective (CBS, 2017).

In the price dashboard the economy is divided into four parts, each of which has four individual price indices. Together with the consumer price index they give an overview of price changes in the overall economy. The four economic categories that are part of the price dashboard are:

- Household consumption
- Capital market
- Real estate and investment
- Production of goods and services

Consumer prices are now part of the price dashboard and are no longer presented as being the only measure for inflation. In the next chapter we describe the individual indicators for inflation in detail. We consider the composition of the price dashboard as given. Relationships between inflation and business cycles is outside the scope of this research.

In this paper we investigate the relationships between the inflation indicators of the price dashboard. Which indicators are leading or lagging to other indicators? How strong is the correlation between the indicators? Investigating this will lead to a better understanding of how the inflation indicators behave over time and how close their relationship is. Our findings could in the end have an effect on the composition of the price dashboard. The price dashboard is intended to have both related and unrelated indicators. The value of having related indicators is that they show which indicators follow a similar pattern. If however two indicators are perfectly correlated, it could be questioned whether they should both be part of the price dashboard. The value of unrelated indicators is that they show the diversity of inflation.

[1] Many thanks to Bart Bakker, Brugt Kazemier, Pim Ouwehand, Henk Verduin and Jan Walschots for their support and comments to this paper. Thanks to Jan de Haan for reviewing this paper.

Special attention in given to the Consumer Price Index (CPI). Until the introduction of the price dashboard, Statistics Netherlands used to measure inflation by consumer prices only. Still, consumer prices are an important figure because policy makers constantly keep an eye on consumer prices. For example the European Central Bank bases its policy on consumer prices. The ECB measures inflation by the HICP (Harmonized Index of Consumers Price), which is very similar to the CPI. The main goal of the ECB is to keep the HICP in the euro area at a level close to, but below 2% (ECB, 2011). In the Netherlands the CPI is used for example in maximum house rental fee increases and in wage negotiations. Because of the central role of the consumer prices in measuring inflation, we zoom in to the behaviour of the CPI and to possible indicators that are leading to the CPI. However, it is not our primary goal to predict the CPI. If we would want to predict the CPI, we would need to take factors into account from outside the dashboard as well. Other research shows that for example monetary values (M0-M3) and worldwide commodity prices are important to predict the CPI (Artis et al. 1995, Seitz 1998). These are not included in the dashboard. We have limited ourselves to the indicators within the price dashboard and investigate to which extent they have predictive value for the CPI.

In this research we will first pay attention to the economic theory in order to explain which indicators are expected to influence each other and influence the CPI. Next, we will test the economic theory by investigating the correlations between the full set of indicators, while shifting indicators backward and forwards in time to find leading or lagging indicators. Finally we investigate whether there are leading or lagging indicators for turning points in CPI.

2. Data description

All data used in this research is retrieved from the CBS price dashboard. This data is on a monthly level and ranges from January 1997 until July 2017. There are three series that are not available for the full period. The 'import industrial products' starts in January 2000 and 'import machinery' starts in January 2005. For 'new build houses there is only data available until February 2017. The full list of the seventeen price dashboard elements is as follows:

- CPI
- Household consumption
    - CPI energy
    - CPI industrial goods (excluding energy)
    - CPI foods
    - CPI services
- Financial markets
    - AEX share price
    - 3-months interest rate
    - Gold price
    - 10-year interest rate (government loans)
- Real estate and investment
    - Price index for privately owned houses
    - Price index of new build houses (proxy)
    - Producer price index of capital goods produced in the Netherlands
    - Import price index of machinery[2]
- Production of goods and services
    - Price index of imports of industrial products
    - Wage rate
    - Price of crude oil
    - Output price of industry

Below, the four segments (except CPI) are described in more detail (CBS, 2017; Kazemier, Zeelenberg and Walschots, 2017.

Household consumption

The first segment is household consumption, as measured in the CPI. Selected components in household consumption are food, energy (natural gas, electricity, et cetera), industrial goods (excluding energy) and services.

[2] Note that the "import price of machinery" is a much smaller category than "capital goods produced in the Netherlands producer price" category. Means of transport and computers are not included in the machinery category, but are included in the capital goods category.

Capital market

The second segment concerns the financial markets. Important indicators here are the long term interest rate (the interest rate on the newest 10-year government loan), the short term interest rate (3-month Euribor) and the share price on the Dutch stock market (AEX). The two interest rate series are the only series on the dashboard that are not 12-month percentage changes. The fourth indicator in this segment is the price of gold.

Real estate and investment

The third segment is fixed assets. Ideally, this segment contains information on the prices of private homes (new buildings and existing houses) and other buildings (offices, shops, warehouses, industrial buildings and so on), the rent of commercial property, the price of machinery, ships, aircraft, vehicles, et cetera. However, only few of these prices are available on a monthly or quarterly basis. For real estate, the price of existing privately owned dwellings and a proxy for the price of new houses have been chosen. Investments is represented by the import price of machinery, equipment and tools and the producer price of capital goods produced in the Netherlands.

The price of newly built houses is approximated by the construction costs of new buildings. The difference is that the price of new buildings also includes the profit margin of the project developer as well as the price of the land on which the property is built.

The construction cost of new buildings is only available on a quarterly basis. In order to reach a monthly series of percentage year-on-year mutations, the quarterly indicators are first projected on the middle month of the relevant quarters. The values for the intermediate months are obtained by linear interpolation. For the most recent months, the value of the most recent index available is duplicated. After that, the 12-month percentage changes are calculated.

Production of goods and services

The last segment concerns the production of goods and services. As indicators we have chosen wage rates, the price of imports of goods and services (excluding energy) and the price of energy. The latter is represented by the price of crude oil. In addition, the output price of industry is important. The output prices of services are not included because they are not available on a monthly basis. However, they are strongly related to wages, and wages are included in this segment.

The wage rate refers to the index of basic wage rates in collective agreements; this excludes overtime payments and additional payments.

3. Results

The aim of this research is to investigate the relationships between the indicators in the price dashboard. Special attention is paid to relationships with the CPI to find leading indicators. We start with a general investigation into trend and variance breaks in CPI. Then we explain for which indicators we would expect a relationship based on economic theory. Afterwards, we will present the maximum correlation between all seventeen indicators, including possible lags, with special attention to the correlation with the CPI or parts of the CPI. Finally, we analyse turning points, because research in predicting CPI is mostly based on predicting turning points in CPI.

3.1 CPI analysis

In this section, the CPI is analysed in more detail. We search for change points in trend and variance to better understand the CPI. There have been a number of possible shocks to the CPI in the analysed time period 1997-2017. The first is the introduction of the euro in 2002. The second is the change in CPI measurement method in 2006[3] and the third is the financial crisis in 2008.

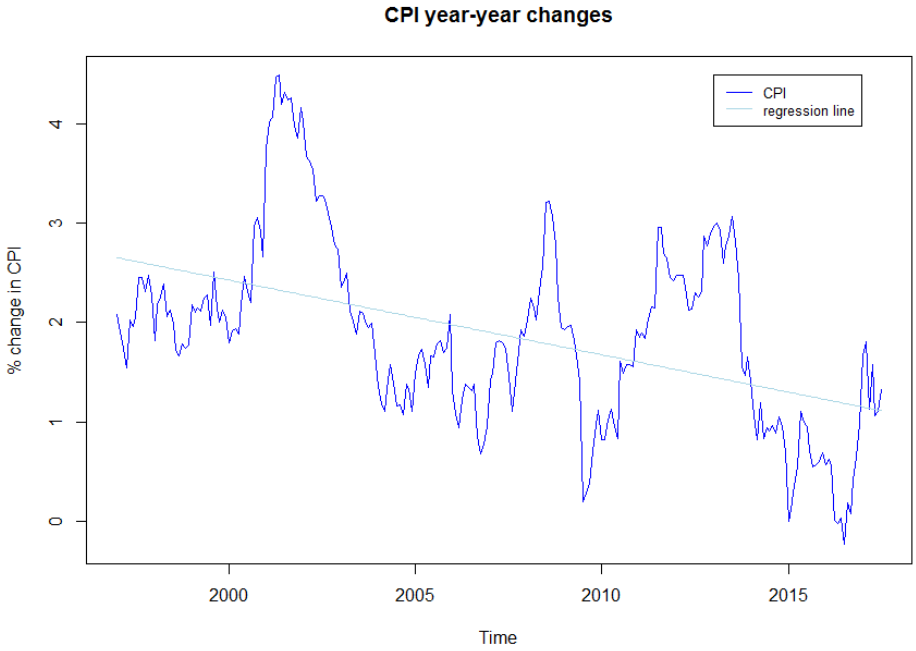


Figure 1 CPI year-on-year changes

The CPI year-on-year change shows the relative difference in CPI between a certain month and the same month one year ago (Figure 1). When we analyse the CPI year-

[3]Details about the changed CPI measurement method: https://www.cbs.nl/nl-nl/onze-diensten/methoden/onderzoeksomschrijvingen/korte-onderzoeksbeschrijvingen/consumentenprijsindex--cpi---2006-100

on-year changes we see that it fluctuates between -0.5% and 4.5% per year. This is not unexpected, taking into account that it is the main goal of the ECB (European Central bank) and the Dutch Central bank to keep inflation close to, but below 2%. When looking at the average inflation of 1.9% over the 1997-2017 period, their goal is closely met. Like many economic variables, also the CPI seems to have a cyclical pattern. Periods with relatively high inflation are followed by periods of relatively low inflation. This pattern however does not seem to be very stable. Length of cycles and heights of peaks and troughs are varying. Interesting to note is that Bikker (1993) shows that for the Netherlands price and business cycles do not coincide.

It is quite difficult to detect real change points in the trend of the CPI. In the long term the inflation is expected to be close to 2%, because of the ECB regime. In the period 1997-2017 we see that this expectation is met over the total period. We also see that the average inflation has decreased over this period. Inflation was relatively high in the first years and relatively low in the last years. If we fit a regression line on this data, we get a decreasing line with coefficient -0.0063, which means an average monthly decrease in year-on-year CPI growth rates of -0.0063 percentage point.

When we look closely at the graph, there is not one clear change point responsible for this overall decrease. Of course we could use an optimisation technique that divides the data into two parts, where the first part would have a relatively high inflation and the second part would have a relatively low inflation. However, it is questionable what the meaning would be of this change point. It could very well be that the cyclical nature of the CPI has more influence on where this point will be than any external event. Therefore we do not look further into this issue.

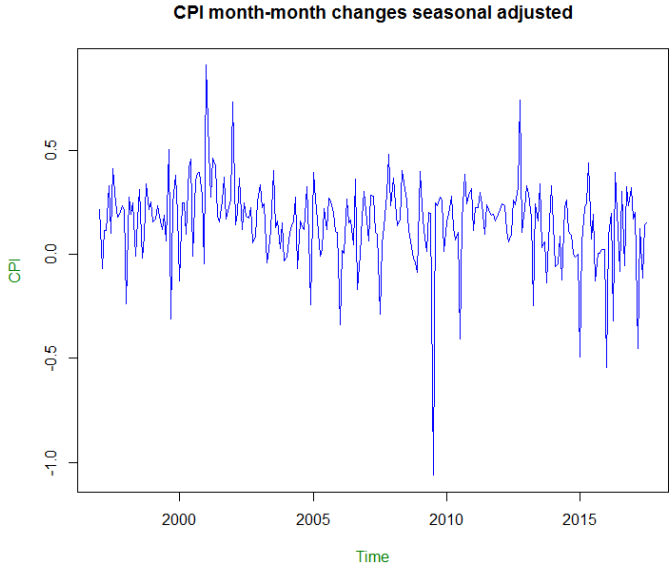


Figure 2 CPI month-on-month changes seasonally adjusted

For investigations in the CPI variance we used the month-on-month changes in seasonally adjusted CPI[4], as shown in Figure 2. From this figure it is not clear whether the variance is changing over time. To investigate this further we plot the sample variance for a rolling 12 period horizon (Figure 3). This means that in month 1 we take the sample variance over month 1-12. In period 2 we take the sample variance over month 2-13 and so on.

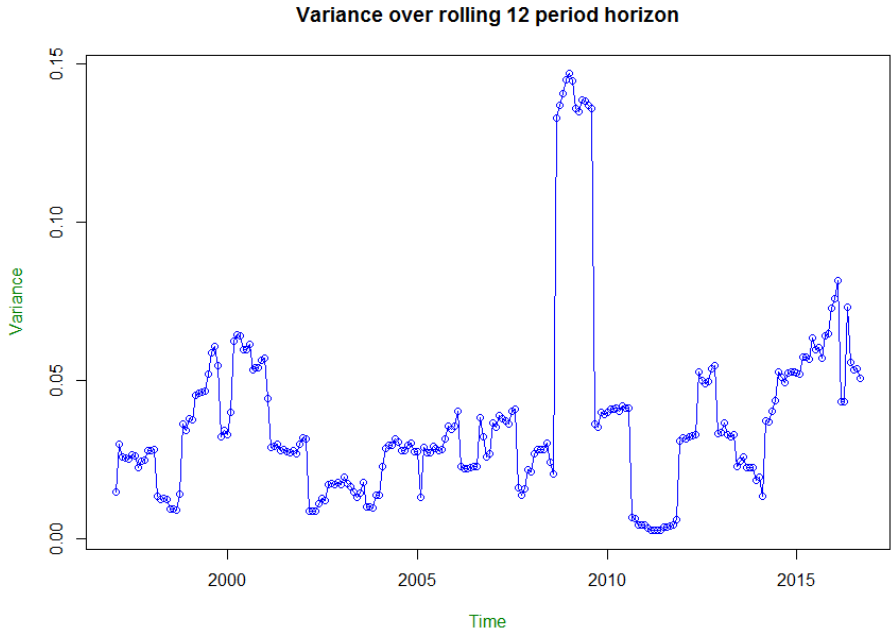


Figure 3 Variance in CPI month-on-month over rolling 12 months horizon

We see high sample variances in the one year periods with a start at September 1999, April 2000, January 2009 and February 2016. To see if the high variance periods could be due to only one or a few consecutive extreme values, we did the same analysis with a 3 months rolling horizon.

[4] The month-month change is the difference in CPI between a certain month and one month earlier. The season is extracted using the x-12 method.

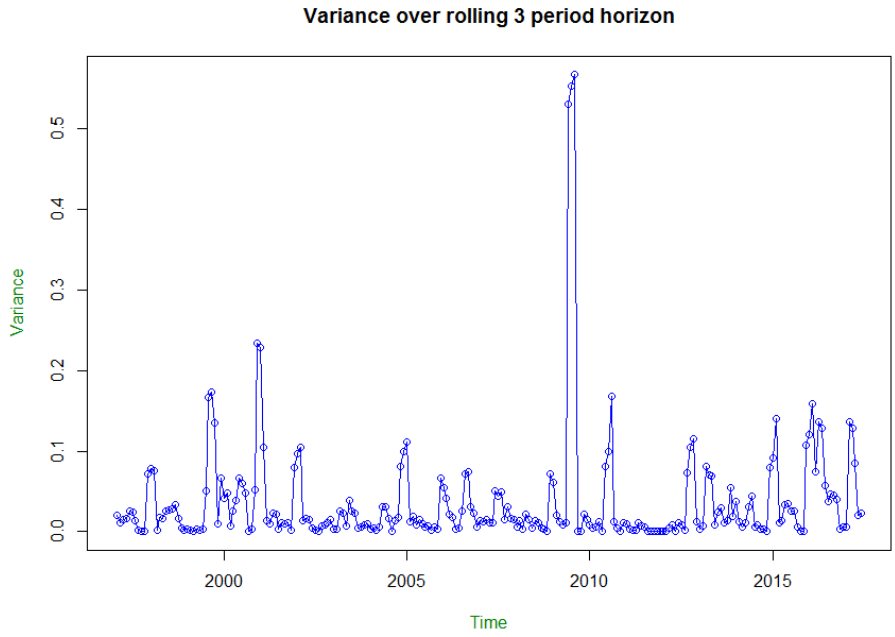


Figure 4 Variance in CPI month-on-month over rolling 3 months horizon

We see that especially the variance peak in 2009 is an example of only one or two consecutive extreme values. The cause of the extreme variance in 2009 can be found in the CBS archive. The CPI year-on-year change in July 2009[5] was 0.2% while it was 1.4% one month earlier. This is an enormous shift when we take into account that the average change in year-on-year changes in CPI is 0.003 percentage point. According to the CBS press release the reason for the decrease in CPI was a huge decrease in energy costs.

Changes in energy costs mostly take effect in January and July, because of contracts in this sector. When we look at the data we are using -the month to month changes in seasonally adjusted data; we see a similar situation. The CPI decreases from 0.20% in June 2009 to -1.06% in July 2009. So this sudden drop in energy prices is the reason for the large variance in 2009.

To investigate if changes in energy prices could have been a reason for more of the peak variances we look at the following graph (Figure 5). As explained earlier the first point in the graph shows the variance over the first three periods; January, February and March. This means that period 4 includes April, May and June and period 5 includes May, June and July. Therefore we consider period 5 as the first period where July is included. These periods are coloured black in the graph below. The same is done for January with colour blue.

[5] https://www.cbs.nl/nl-nl/nieuws/2009/32/laagste-inflatie-sinds-1987

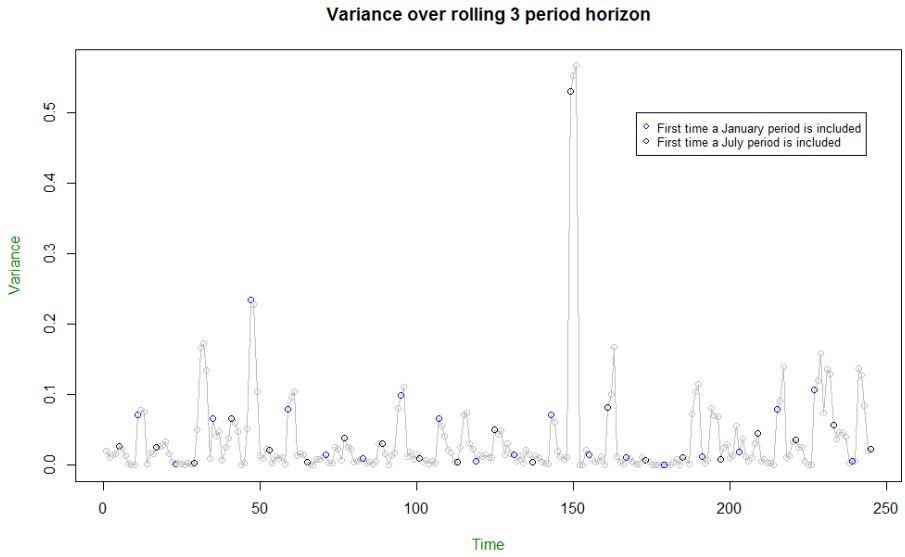


Figure 5 Variance in CPI month-on-month over rolling 3 months horizon and different colours for January and July

We see in the graph that indeed CPI variance tends to be higher when January or July months are included. However, we cannot conclude that this behaviour is only because of energy contracts, since there are other prices that are also updated in January and/or July only. For example housing rental fee is only updated in July. For the example of July 2009 we found that the housing rental fee increase had an increasing effect on CPI of 0.1 percentage point and the drop in energy prices had a decreasing effect on CPI of 1.0 percentage point. So for July 2009 we see that the main effect was caused by energy prices and not by rental fee. This could be different for other years. More research would be needed to draw conclusions about what are the exact causes of increased variance in January and July. This research should start with examining old CBS press releases.

Looking at the graphs it looks as if the variance has been higher than average over the last three years. This is not the first time we have such a period, since variance was also high around 2000. It is a known phenomenon that inflation series can have a fluctuating variance and therefore heteroscedasticity[6].

[6] Commandeur, Koopman (2007) "*This phenomenon [heteroscedasticity] in inflation series (and other macroeconomic time series) is recognised by many economists and is debated in the literature, see for example Stock and Watson (1996).*"

3.2 Economic background

Before turning towards econometric models, we analyse the economic background for expected relationships between indicators. Basically there are three types of factors that influence inflation (ECB, 2011, pp.55 -56; FRB, 2012, pp. 30-32):[7]

- *Demand factors*: changes in demand, e.g. owing to changes in consumer or producer confidence or credit restrictions, may lead to changes in inflation;
- *Cost and supply factors*: supply shocks, e.g. changes in technology, tax rates, and the supply of primary commodities, may affect the level of prices;
- *Monetary factors*: In the long run, inflation is a monetary phenomenon, i.e. the money supply and monetary policies determine the level of inflation. Demand and cost factors in themselves can only lead to long run inflation or deflation if they are accommodated by corresponding changes in the money supply. Changes in the money stock either directly or indirectly through changes in interest rates, may therefore affect inflation.

Our analysis is restricted to relations between indicators in the inflation dashboard, and that means essentially that we look only at reduced-form relations between variables that influence inflation; so we do not try to disentangle the separate contributions of these three types of factors. Our description of the inflation process and the relations between inflation indicators is also based on the empirical analysis of inflation in the Netherlands (Den Reijer and Vlaar, 2006) as well as the description of wage and price formation in macro-econometric models of the major policy advisors in the Netherlands (CPB, 2011; DNB, 2011).

First of all we look at the CPI and which variables are expected to be related to the CPI or to one of the parts of the CPI. The first one is the price of **crude oil** (Hamilton, 1983; Hunt et al., 2002; Barsky and Kilian, 2004; Kilian, 2008a, 2008b; Barrell et al., 2011). Since crude oil is one of the main industrial input products, it is expected that an increase in price of crude oil will be followed by an increase in finished goods prices and thereby an increase in the CPI. The effect will be seen especially in CPI energy. Part of this change is expected to occur already in the same month, because gasoline sellers have a rapid system of updating their prices. Another part will only be seen after a number of months, because energy contracts can only be revised once or twice a year. Apart from these direct influences, oil prices may more generally influence inflation expectations, and lead indirectly to actions by producers or policy makers. And thirdly, especially large increases in oil prices may be an incentive for energy-saving measures, which may lead to changes in aggregate supply and demand; in the period we consider, 1995-2016, this may have been less the case.

The second variable that is expected to be related to the CPI is **wages**. The effect is two-sided. On one hand, labour is an important input in production, especially in labour-intensive services. So when wages increase consumer prices, in particular of services, are expected to increase as well (CPB, 2001, section 4.6). The expected lag is

[7] We focus here on the analysis of inflation and monetary policy by central banks, since they are the main policy makers and analysts of inflation.

a few months. On the other hand, when the CPI increases, wages are also expected to increase to make up for the increased cost of living. In modern models of wage formation, wage rates are set in a bargaining process between employers and trade unions (Graafland and Huizinga, 1999; Peeters and Den Reijer, 2006). For both bargaining parties, the development of prices is an important element: for employers because the difference between price and wage determines profits, and for trade unions because it determines real wages. The expected lag is a number of months with a maximum of one year, because wage rates in general only change once a year. However, the number of automatic escalators, which were quite common in the sixties and seventies, has diminished greatly.

The third variable expected to be related to CPI is the **import price of industrial products**. Again, there are two effects. On the one hand, part of these imports are inputs in production and an increase in input prices leads to higher productions costs and is expected to lead to increased consumer prices. This effect is expected to be especially seen in the CPI industrial goods. On the other hand, imports of industrial goods compete with domestic industrial goods, and a change in the import price will give domestic producers an incentive to follow (Zeelenberg, 1986, chapter 6; Coutts and Norman, 2007).

The fourth and fifth variable expected to be related to the CPI are the **producer price** of **capital goods** and **the import price of machinery**. Increases in both fields will lead to increased producer costs and increased producer prices and thus increased consumer prices. This effect might be visible especially in CPI industrial goods and maybe in CPI food.

The relationship between CPI and the two **interest rate indicators** is expected to be twofold. Since interest rates are one of the components of capital cost and thus of production costs, an increase in interest rates, may lead to higher CPI. Short-term interest rates are also one of the monetary-policy instruments, and so they might be used to influence inflation; this would lead to a negative relation between interest rates and inflation. So taken together, the relation between interest rates and inflation will be ambiguous and therefore we do not include it in the analysis with leading indicators for CPI.

When we look at the non-CPI variables, we expect a relation between the two interest rate variables **3 month interest rate** and **10 year interest rate** and the **house prices privately owned houses** and **new build houses**. A higher interest rate is expected to lead to a decrease in house prices. The higher interest rate will make the houses more expensive (indirectly) and therefore lower the demand for houses and thus lower the house price.

The only two variables that are not mentioned so far are **AEX** and **gold price**. We do see some indirect possible relations, but also realise that both are very volatile because they are heavily used for speculations. Historically they were related to each other, but this seems not to be the case anymore. Therefore we do not expect any clear relationships when including any of these two variables.

3.3 Correlation

The correlation between indicators can be used to determine how closely two indicators move together. We use the correlations to determine how tight the relationships are between the indicators within the dashboard. Besides, we investigate which indicators are highly correlated with the CPI to find indicators with predictive value. Not only the correlation is investigated, but also the lags under which correlation is maximised. This will show whether indicators are leading or lagging and with which lead time.

We start by explaining our method using the interesting findings regarding CPI and wages. Afterwards we will provide the correlation for all indicators including optimal lag and discuss what we can conclude from this.

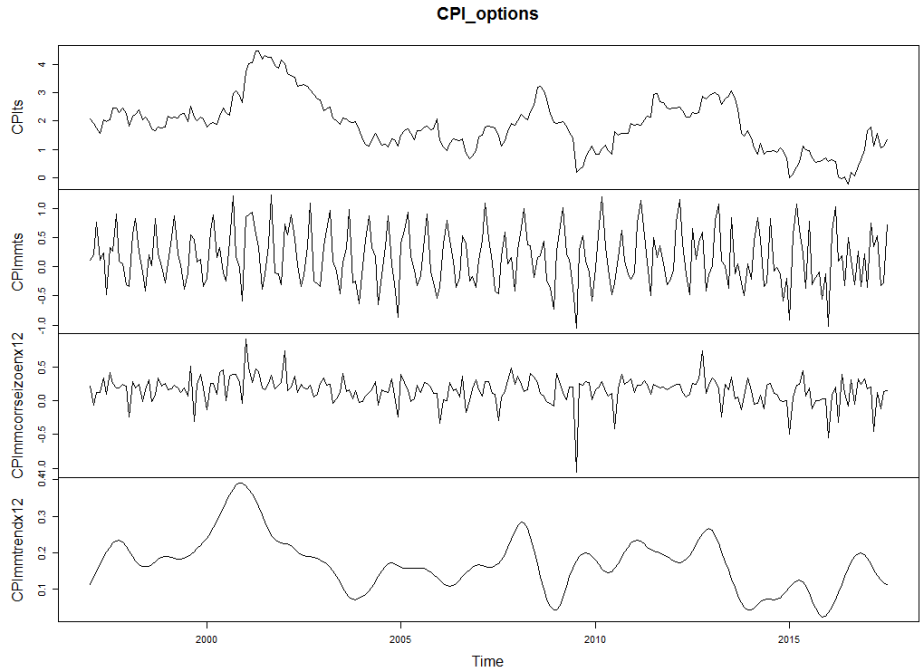


Figure 6 CPI year-on-year changes, month-on-month changes, seasonally adjusted month-on-month changes and trend for month-on-month changes

During this research we have analysed several different ways of representing the data. CPI analyses are usually done on year-on-year changes. However, when looking at correlations we did not want to use year-on-year changes. The reason for this is that we want to evaluate the effect of events that happen in a certain month. When we would use the year-on-year changes the effect of something that happens in one month will be spread out over a full year. To illustrate the problem with year-on-year changes we use a theoretical example. Let's say we have a steady CPI index of 100. Then in March 2030 the CPI index increases to 110 because of an increase of indicator X one month earlier (February 2030). In month-on-month changes we

would see 0% increases of all months except March and a 10% increase in March. In year-on-year increases we would see 0% increases until March, then in March 2030 until February 2031 we would see an increase of 10% and afterwards 0% again. So the effect of the increase in March is included in twelve periods of year-on-year changes and only in one period of month-on-month changes. Including the effect of one event in twelve periods makes the correlation analysis more problematic, because correlations coefficients with lags from one until twelve months will have high coefficients whereas the effect in this case has a clear lag of one. Taking into account that in reality a lot of small fluctuations are happening, we expect that the month-on-month changes give a better understanding of the lag between two indicators. However, we also see that the month-on-month changes are too volatile to give good correlation results even after adjusting for seasonality. Therefore we use the trend in month-on-month changes[8].

Wages have an interesting relationship with CPI. On one hand an increase in the CPI is expected to cause a raise in wages, because wages will be increased to compensate for the CPI increase. On the other hand, a raise in wages will cause a raise in the CPI mainly through the CPI for services. Higher wages will cause higher prices for services.

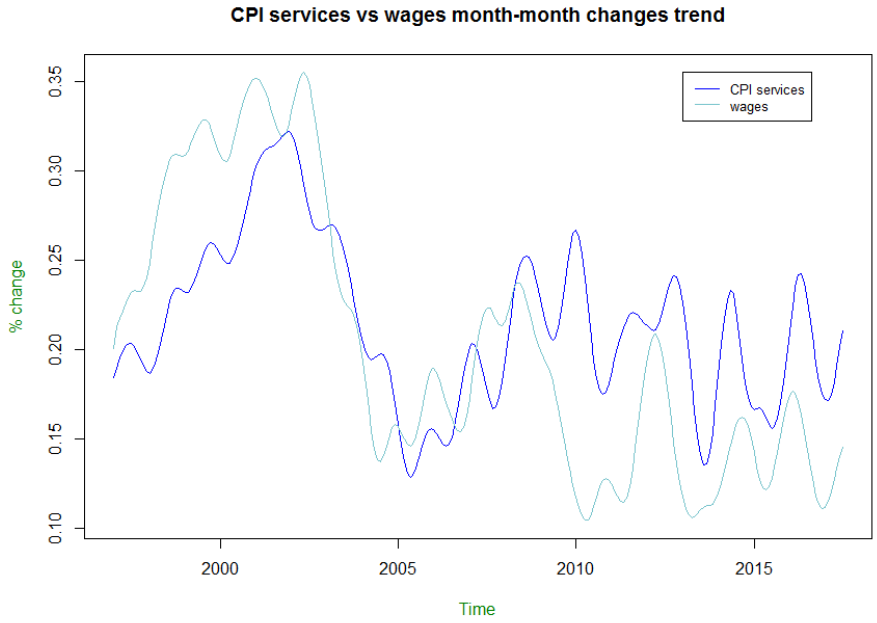


Figure 7 CPI services vs wages month-on-month changes trend

When calculating the cross-correlation, we see that the highest correlation occurs at a lag of 6 months and the corresponding correlation is 0.74. This means that the CPI services at time t + 6 has a correlation with wages at time t of 0.74. So if wages rise now, it is expected that the CPI services will also rise in the next months. We see that the effect is spread over a larger period and has a peak effect at six months.

[8] The trend is extracted using the X-12 method.

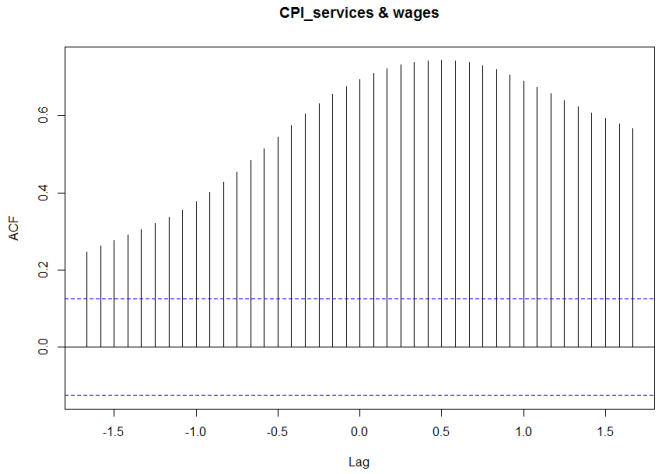


Figure 8 Cross correlation CPI services and wages

When we compare the wages with the total CPI we see indeed the twofold relation. Higher wages lead to a higher CPI and a higher CPI leads to higher wages. This is seen in the picture below, because both at positive and negative lags there is a positive correlation.

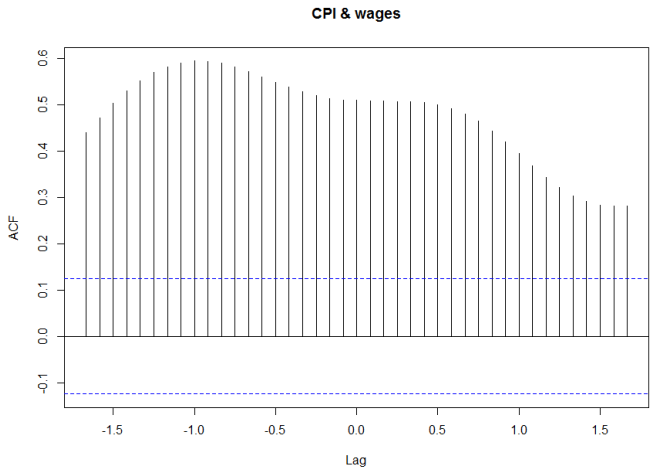


Figure 9 Cross correlation CPI and wages

The correlation between CPI and wages is the highest at a lag of -1 year. This would mean that on average one year after a rise in CPI the rise in wages is the highest with a correlation of 0.59. This result is influenced by the relation we saw earlier between wages and CPI services. To exclude this effect, we also look at the correlation between the CPI excluding services and wages.

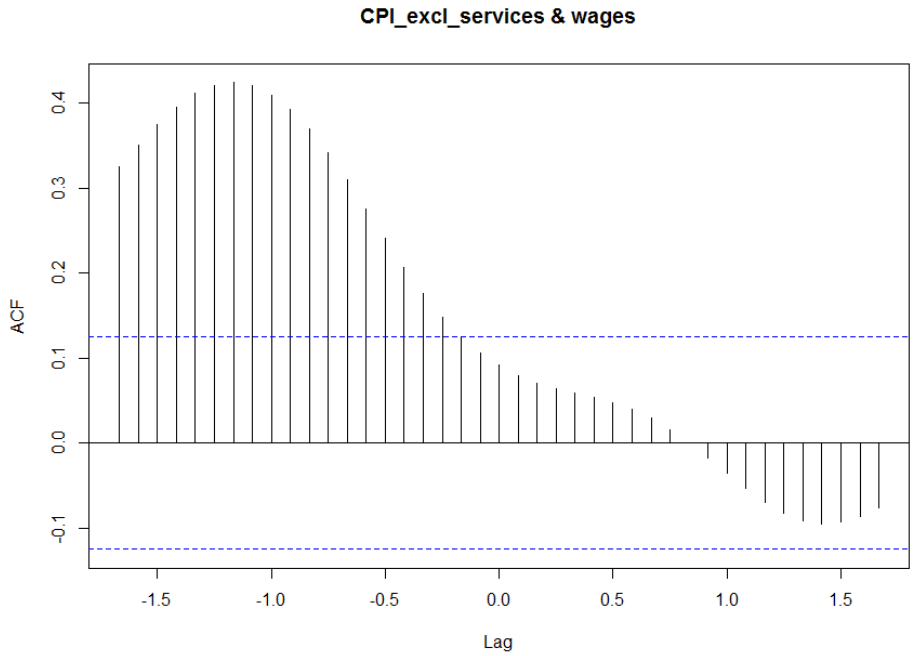


Figure 10 Cross correlation CPI excluding services and wages

We see that now the effect on the CPI services is removed, there is a clear relationship between the CPI excluding services and wages with a lag of more than a year. The maximum correlation is at a lag of -14 months and has a value of 0.42. This means that on average 14 months after an increase in CPI, the rise in wages is highest with a correlation of 0.42.

3.4 Cross correlation matrix

After the detailed investigation of CPI and wages, we will now discuss the general results. In table 1 we show the maximum correlation between indicators[9]. Between brackets the optimal lag at which this correlation is found is shown. Note that the lag is applied to the indicator on the top row. So for example between wages and CPI services the optimal lag is -6 and should be applied to CPI service, because this is the parameter on top. This means that 6 months after an increase in wages the effect on CPI services seems to be highest.
We choose only to show correlations that in absolute terms are higher than 0.5. We have removed the gold price and the AEX share price index from the table, since there are no correlations larger than 0.5 with any of the indicators. The full table is shown in the appendix.

[9] Not only correlations, but also cointegration with lags was investigated using the Engle-Granger two step method. We found similar results for cointegration. For details about the concept of cointegration refer to Engle, Granger (1987).

	CPI	CPI energy	CPI industrial goods	CPI food	CPI services	3-months interest	10-year interest
CPI	1 (0)						
CPI energy	0.59 (-3)	1 (0)					
CPI industrial goods	0.53 (1)		1 (0)				
CPI food	0.66 (3)	0.55 (9)		1 (0)			
CPI services	0.61 (16)		0.61 (13)		1 (0)		
3-months interest	0.54 (4)				0.54 (-14)	1 (0)	
10-year interest						0.88 (0)	1 (0)
Import price industrial products		0.67 (2)					
Wages	0.59 (12)		0.55 (12)		0.74 (-6)	0.76 (3)	0.71 (0)
Crude oil price		0.73 (-2)					
Output price industry		0.81 (0)					
Privately owned houses			0.53 (-11)		0.65 (-20)	0.7 (-16)	0.63 (-20)
New build houses					0.56 (-17)	0.59 (-9)	0.56 (-12)
Capital goods producer price							
Import price machinery							

Table 1 Cross correlation matrix with optimal lag part 1. The lag with maximum correlation is shown between brackets. The lag must be applied to the indicator on the top row.

	Import industrial products	Wages	Crude oil price	Output price industry	Privately owned houses	New build houses	Capital goods	Import price machinery
CPI								
CPI energy								
CPI industrial goods								
CPI food								
CPI services								
3-months interest								
10-year interest								
Import price industrial products	1 (0)							
Wages		1 (0)						
Crude oil price	0.62 (-4)		1 (0)					
Output price industry	0.78 (-1)		0.83 (2)	1 (0)				
Price privately owned houses		0.85 (-18)			1 (0)			
New build houses		0.62 (-7)			0.6 (7)	1 (0)		
Capital goods producer price	0.71 (1)		0.51 (7)	0.56 4)			1 (0)	
Import price machinery							0.53 (2)	1 (0)

Table 2 Cross correlation matrix with optimal lag part 2. The lag with maximum correlation is shown between brackets. The lag must be applied to the indicator on the top row.

There are a number of interesting observations. First of all the gold price and the AEX appear not to be correlated with any other index (and are therefore not shown in the table). This confirms our expectation that gold and AEX share prices have no clear relationship with any of the other indicators.

We do see some of the relationships we expected. The maximum correlation between the crude oil price and CPI energy is 0.73 where crude oil leads two months on CPI energy. Also the relationship between wages and CPI services as described earlier is clearly visible. There are also some expected relationships that are not confirmed. These are the correlation between CPI industrial goods and import price of industrial products, price of capital goods and import price of machinery. We expected a positive correlation where the indicators would be leading to CPI industrial goods, but we did not find this. Only a correlation between import price of industrial products and CPI energy is visible, which was however not expected.

Between the interest rates and the house price indicators we find positive correlations where we would expect negative correlations. Besides, we would expect the interest rates to be leading the house prices. This is not confirmed by the analysis, because all optimal lags are pointing towards the opposite direction of interesting rates lagging behind house prices. We expect that a shock in house prices is responsible for this. From 2008 until 2015 the house prices have been decreasing as well as the interest rates. This can explain the positive relation that we found.

Furthermore we find some high correlations we cannot explain by a direct causal relationship, for example the correlation of 0.85 between the price of privately owned houses and wages. It could be that they are both related to a third variable outside the price dashboard, for example economic growth.

3.5 Turning points

Most research on predicting inflation is on predicting turning points of inflation. The reason for this is that it is very difficult to predict the absolute value of the rate of change in the CPI (Garner 1995). Predicting turning points is easier and is therefore the most common method (e.g. Bikker 1993, Artis 1995, Seitz 1998). Therefore we analyse how well the turning points in other indicators can predict turning points in the CPI.

Other research shows that composite indexes of leading indicators are better at predicting turning points than single indexes. For example Garner (1995) shows that composite indexes as the PaineWebber index, Journal of Commerce index, Center for International Business Cycle Research index and Commodity Research Bureau index are better predictors than the single price of gold index. Seitz (1998), Bikker (1993), Roth (1986) and Artis (1995) all use composite indexes to predict turning points in inflation. Mostly the composite indexes include information from different economic areas, like commodity prices, financial indicators and the state of the real economy.

In this research we investigate which of the indicators would be most suitable to be included in such a composite indicator by investigating how well the individual indicators predict turning points in CPI.

For the same reason as in the correlation analysis we choose to use the trend from X-12 method.

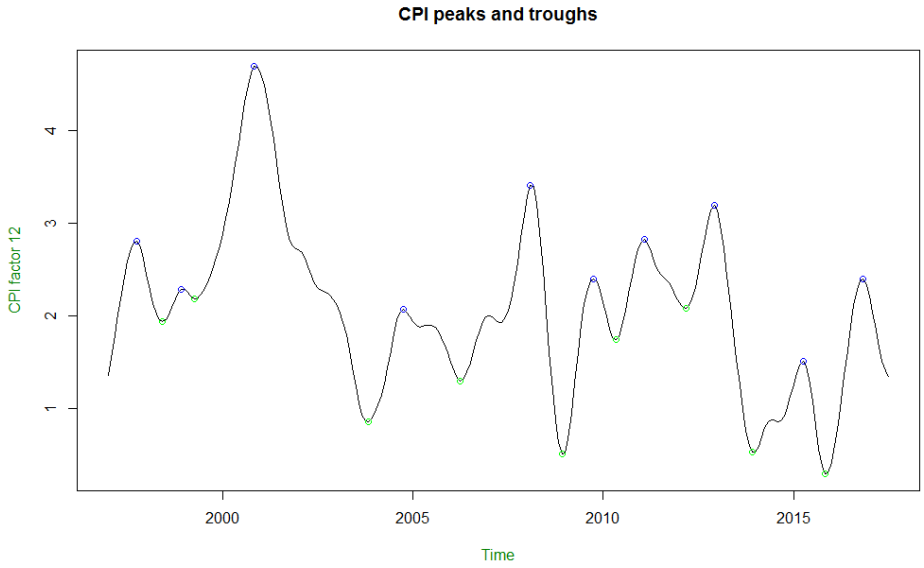


Figure 11 CPI trend turning points

One of the downsides of using the month-on-month changes, is that the resulting percentage changes in the CPI are relatively small and are not very intuitive. To make the numbers more intuitive, we multiply them by 12 to approximate[10] what the yearly CPI would be if the CPI stayed at this level for the whole year. This is only used for graphical representation and does not change any of the results.

The method we used to define peaks is to declare a peak if there is no higher point in the area of one year centred[11] around the point itself. The opposite is done to find troughs. If there are multiple peaks in row without a trough in between, the highest peak is retained and the others are removed. A similar step is also part of the Bry Boschan method to detect peaks (Bry Boschan, 1971). Again, the opposite is done for troughs.

We only investigate the indicators for which there is economic theory explaining its relationship with the CPI. Further, we do not investigate relationships with subseries of the CPI, like the relationship between crude oil and CPI energy. The reason is that we assume that policy makers are interested in predicting turning points in the CPI itself and not in predicting turning points in CPI energy.

[10] This is an approximation, because we would need to use ((1 + factor/100)^12 – 1)*100%. The difference between the two methods is very small for small changes.
[11] Centred by taking the 5 previous months and 6 succeeding months.

3.5.1 Price of crude oil and CPI

The peaks and troughs in price of crude oil are shown in the graph below.

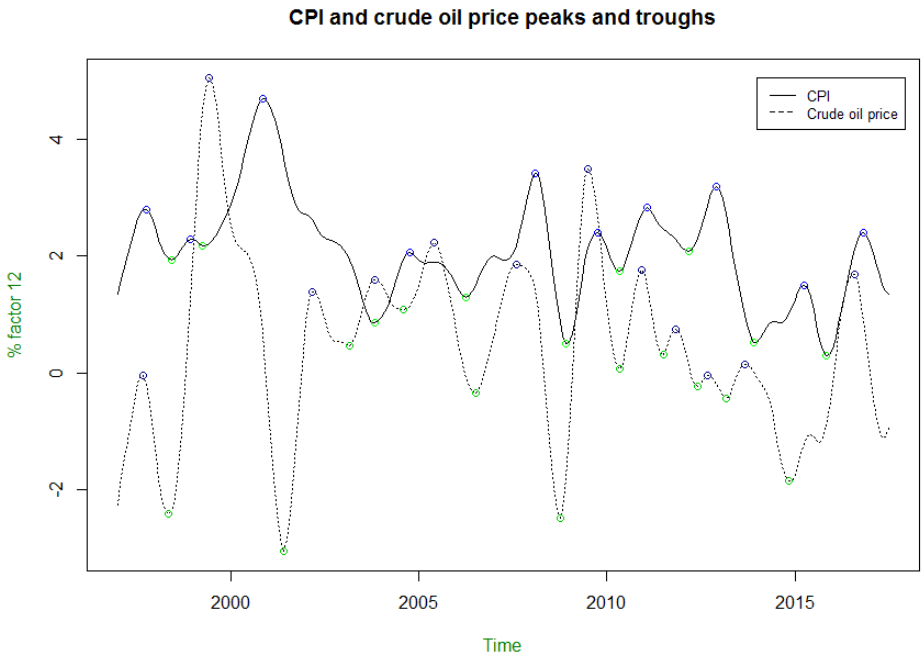


Figure 12 Crude oil price turning points. A factor 1/30 is used to scale the crude oil price.

The peaks and troughs in crude oil price are linked to peaks and troughs in the CPI. We do not consider negative lead times because we are assuming the crude oil price is leading the CPI. If the lead time between turning points in the crude oil price and the CPI is more than 18 months we do not link them, because it is unlikely that they are still related. Details of which peaks and troughs are linked can be found in the appendix.

We find an average lead time in peaks of 5.8 months and an average lead time in troughs of 5.7 months. The lead times vary between 0 and 17 months. The standard deviations are respectively 5.52 and 4.64. A distribution of the lead time is shown below.

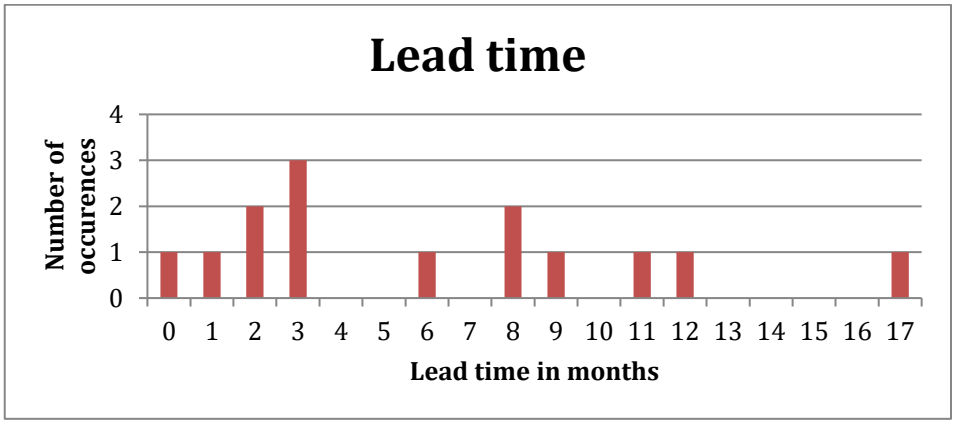


Figure 13 lead time crude oil price turning point to CPI turning point

We see that the lead time is varying a lot. So after a turning point in crude oil prices it can take zero to seventeen months before there is a turning point in the CPI. Out of the nineteen turning points in the CPI fifteen are preceded by a turning point in crude oil prices. Eight turning points in crude oil prices were not followed by a turning point in the CPI.

Note that if the first turning point in the CPI was not preceded by a turning point in crude oil prices this was not counted as turning point that had been missed, because it could be that the turning point in crude oil prices occurred outside our data range. The same holds for the last turning points in crude oil prices; if it is not followed by a turning point in the CPI we do not count this as missing because the turning point in the CPI could be outside our data range.

3.5.2 Wages and CPI

The peaks and troughs in the wage are shown in **Figure 14**.

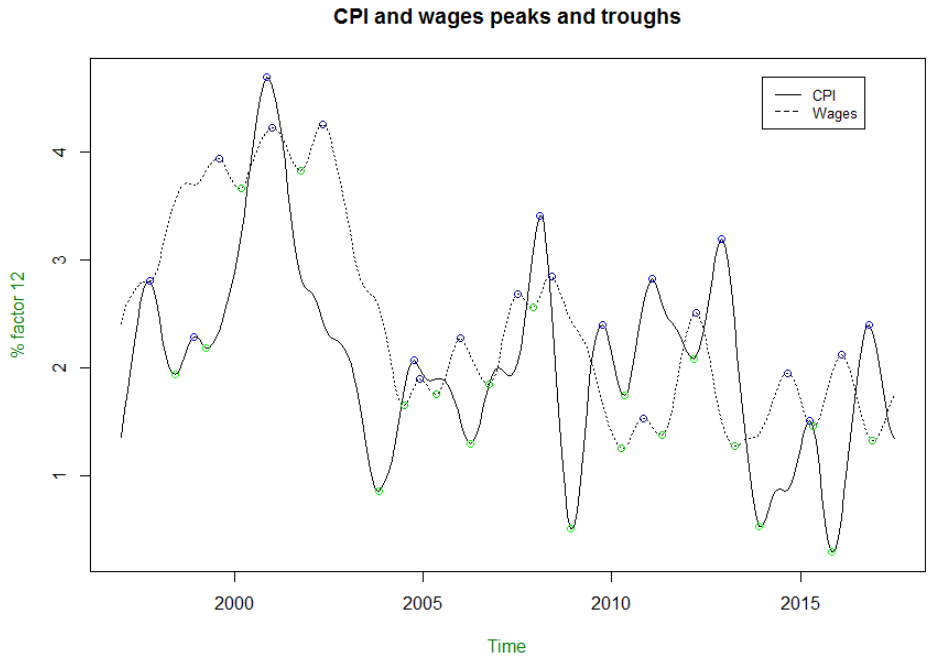


Figure 14 CPI and wages turning points

The average lead time between peaks is 9.3 months and between troughs is 8 months. See the appendix for the detailed linking. Exactly the same strategy is used as for crude oil prices.

Interesting to notice is that out of the first 7 turning point in CPI only one is preceded by a turning point in wages. All twelve succeeding CPI turning points are preceded by a turning point in wages. So the relationship in turning points between CPI and wages seems to have grown in strength over time.

When we look at the lead times it seems as if they are a bit more steady than the lead times of crude oil prices. This is confirmed by the standard deviations in lead time of respectively 4.64 and 4.05 which are lower than the standard deviations for crude oil prices.

Four turning points were missed, which means that four turning points in the CPI were not preceded by turning points in wages. Note that the first two turning points in the CPI were not count as missed, though there was no preceding turning point in wages; it could be that there have been turning points in wages outside the data range. There have been 8 false signals, where a turning point in wages was not followed by a turning points in the CPI.

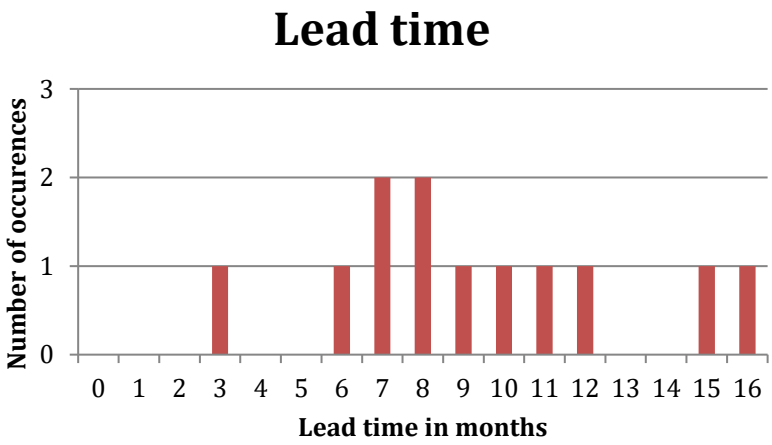


Figure 15 lead time wages turning point to CPI turning point

3.5.3 Import price of industrial goods and CPI

For the import price of industrial goods we only have information since 2000.

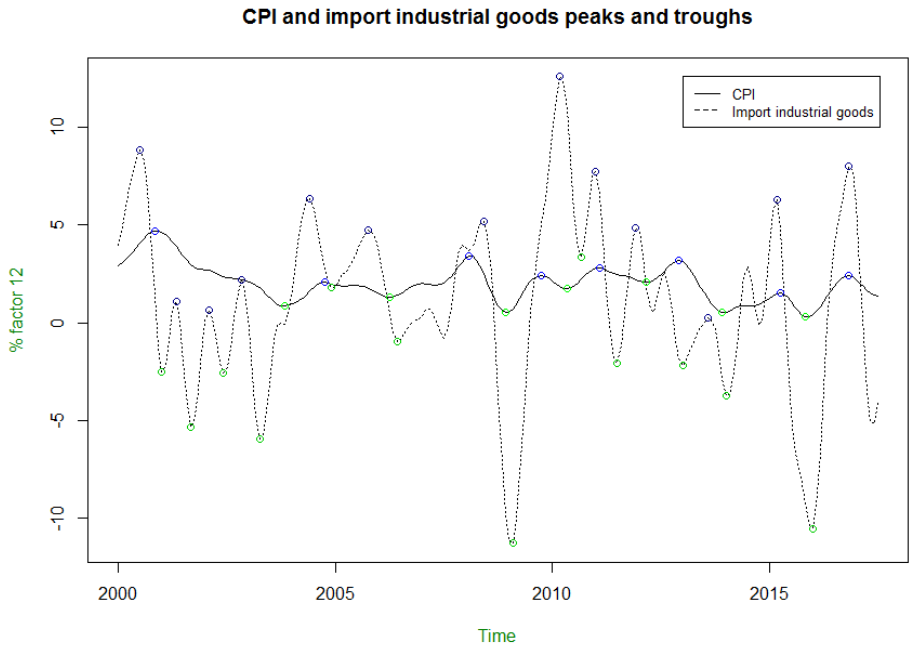


Figure 16 CPI and import price of industrial goods turning points

The first four turning points in CPI are before 2000 and cannot be compared against the import price of industrial goods. See the appendix for the detailed linking. Exactly the same strategy is used as for crude oil price.

Three turning points in the CPI are missed out of a total of fifteen turning points in this period. An interesting observation is that we observe thirteen false signals. Compared to the twelve true signals, this is a lot. More than fifty percent of the turning points in the import price of industrial goods is not followed by a turning point in the CPI. Average lead time for peaks is 5.4 months and for troughs 11.4 months. The standard deviations in lead time are 6.16 and 4.04, which is quite high.

We see that there are three occasions where there are fifteen or sixteen months between a turning point in the import price of industrial goods and a turning point in the CPI. It is questionable whether there is a real link between the turning points in this case. All in all, this indicator seems not such a good predictor.

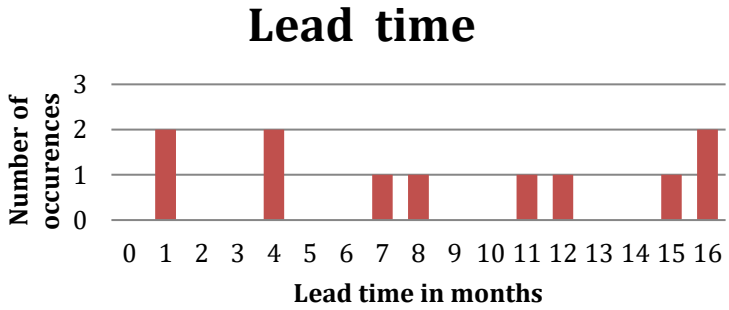


Figure 17 lead time import price industrial goods turning point to CPI turning point

3.5.4 Capital goods producer price and CPI

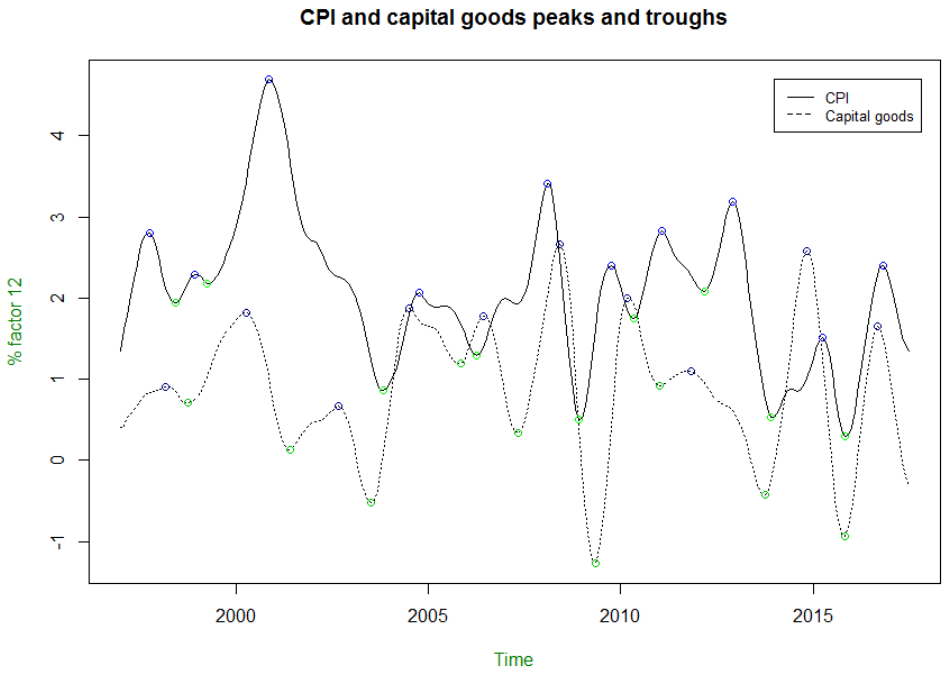


Figure 18 CPI and capital goods producer price turning points

Out of seventeen turning points in the CPI fifteen are preceded by a turning point in the capital goods producer price. Besides, there are only four false signals. Average lead times are 8.3 months for peaks and 6.1 months for troughs with standard deviations 4.92 and 5.11. So again, the variance in lead time is large for this indicator.

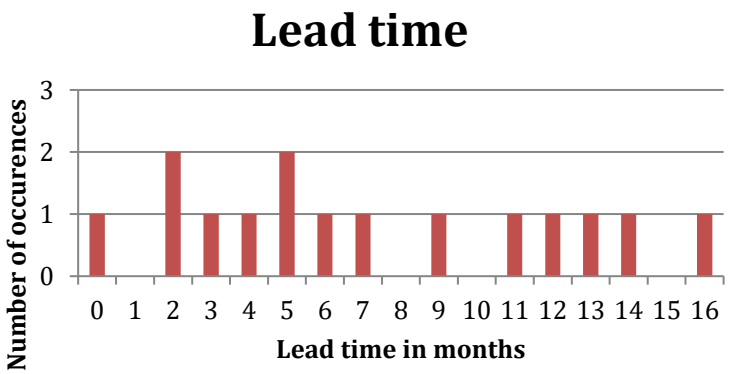


Figure 19 lead time capital goods producer price turning point to CPI turning point

3.5.5 Import price machinery

Import price of machinery is only available since 2005.

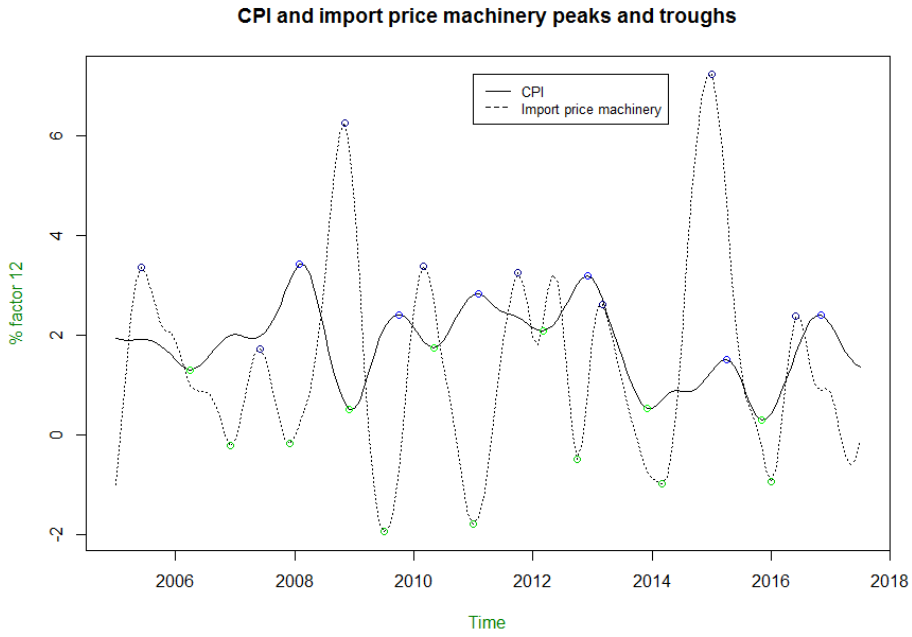


Figure 20 CPI and import price machinery turning points

The import price of machinery seems to be one of the better predictors. Out of eleven turning points in the CPI only one is missed. Three false signals are given. Average lead time for peaks is 8.5 months and for troughs 12.5 months with the extremely low standard deviations of 3.89 and 1.91.

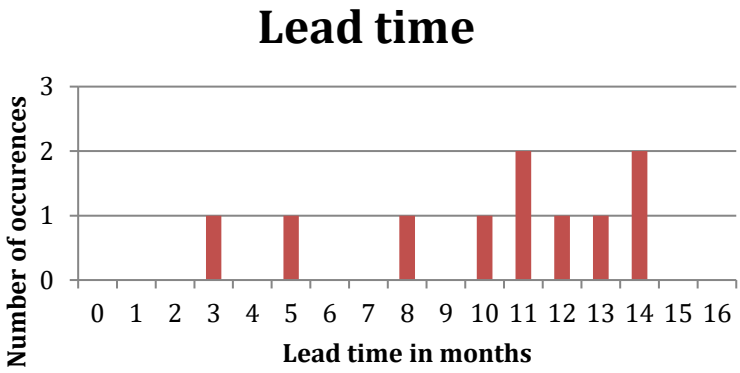


Figure 21 lead time import price machinery turning point to CPI turning point

3.5.6 Comparison to the literature

It is interesting to compare the indicators that were found to be most relevant as part of a leading indicator for inflation in the literature with the indicators of the price dashboard. Quite some relevant indicators from the literature are not included in the price dashboard. For example the monetary indicators (M0 - M3) were often mentioned as being relevant as leading indicators and are not included in the price dashboard (e.g. Artis 1995, Seitz 1998). The same holds for commodity prices (Bikker and Kennedy 1999). For the situation in the Netherlands specifically, the German long term interest rate was proven (Bikker 1993) to be more relevant than the Dutch long term interest rate (correlation 0.56 versus 0.47). German interest rates are also not

included in the price dashboard. Further, it turns out that even though some indicators seem very similar, their added value as leading indicator can be quite different. For example the negotiated wage rates and unit labour costs are both included in the research by Seitz (1998), who showed that the unit labour costs were more relevant than the negotiated wage rates in the nineties. The price dashboard only includes the negotiated wage rates. A more detailed description of literature about leading indicators for inflation is given in the appendix.

A key difference between the literature and our research is that we are not primarily interested in predicting the CPI. Our main research question is about the relationship between all indicators and whether the indicators are leading or lagging the CPI. If we would want to predict the CPI, we would need to include information from outside the dashboard as well, for example monetary aggregates or German interest rates.

3.5.7 Conclusion turning points

When summarizing all results we see that import price of machinery would be the best indicator to include in a composite leading index. Its lead time is most stable and it missed only one turning point. This is a remarkable result, since we found that the correlation between the import price of machinery and the CPI is relatively small. Note that the import price of machinery is only available from 2005 onwards, so the results are based on a limited number of turning points and we expect that the good results are rather a matter of coincidence than that we found a real strong relationship. The second best predictor would be the capital goods producer price, because of its high number of predicted turning points and low number of false signals. Another candidate predictor would be wages, because the last twelve CPI turning points were all predicted by this indicator. The downside of all predictors except import price machinery is the high variance of the lead time. Again, we emphasize that there is no single leading indicator suitable for predicting turning points and therefore one must work with composite indicators.

A side note is that for practical purposes it would often be preferred to have indicators with a high lead time to CPI, because then it is possible to predict further in the future. We see that the import price of machinery and wages have the highest average lead times.

	Turning points predicted	False signals	Lead time peak (standard deviation in months)	Lead time trough (standard deviation in months)
Crude oil price	81%	38%	5.8 (5.52)	5.7 (4.64)
Wages	76%	38%	9.3 (4.64)	8 (4.05)
Import price industrial goods	80%	52%	5.4 (6.16)	11.4 (4.04)
Capital goods producer price	88%	21%	8.3 (4.92)	6.1 (5.11)
Import price machinery	91%	23%	8.5 (3.89)	12.5 (1.91)

Table 3 Results leading indicators for CPI turning points analysis

When this method is used in practice to predict turning points in the CPI, note that signalling rules would have to be defined to detect turning points in leading indicators. In this research we could easily determine peaks and troughs because we used historical data. In practice it is quite difficult to determine for the present moment whether there might have been a turning point recently. For example having one decrease after a period of increases does not necessarily mean there has been a peak. It might be that there is an increase again in the next period. Moreover, smoothing and seasonal adjustments can move a turning point forwards or backwards when new information becomes available. Signalling rules often require a number of periods of decline, together with rules about the relative size of the decline, before a peak is signalled. Examples of signalling rules can be found in Webb (1995), Bikker and Kennedy (1999) and Roth (1986).

The method of using leading indicators cannot only be used to predict turning points in the CPI, it can also be used to confirm whether the CPI has had a recent turning point. This can be done by checking whether the leading indicators have had a turning point. If this is the case, it is more likely that the CPI has had a recent turning point as well. Investigating what would be a good method for confirming turning points and how appropriate the current indicators are to confirm CPI turning points could be a topic for further research.

3.6 Conclusion

There is a number of conclusions to be drawn from this research. The first conclusion is that gold and AEX are only to a limited extent related to the other inflation indicators of the dashboard. This could be a reason to keep them included in the dashboard because they add diversity. It could also be a reason to exclude them from

the dashboard, because they are more based on speculations than that they are related to inflation.

For the indicators that were expected to be related to the CPI we found the following. Correlations are especially high when related to a subseries of the CPI. The crude oil price is highly correlated with the CPI energy and wages are highly correlated with the CPI services. We were expecting more in terms of correlation with the CPI for the import price of industrial goods, the import price of machinery and the capital goods producer price. Their correlation with the CPI was however relatively small.

Furthermore we found that interest rates and house prices did not have negative correlations as we expected. Instead, the maximum correlations were positive. The reason for this is possibly the simultaneous decrease in house prices and interest rates in the years during and after the global financial crisis (period 2008 - 2015).

When comparing turning points between the CPI and leading indicators we found that the import price of machinery is the best predictor of CPI turning points. This is a remarkable result, since its maximum correlation with CPI is relatively small. It has to be noted that this is based on a limited amount of data, because the import of machinery price is only available since 2005. In general we found that the lead time between a turning point in leading indicators and a turning point in CPI has such a high variance that predictions are not very valuable. An alternative way to use leading indicator turning points would be to confirm CPI turning points, which could be a topic for further research.

References

Artis, M. J., Bladen-Hovell R. C., Osborn, D. R., Smith, G and Zhang, W. (1995). Predicting Turning Points in the UK Inflation Cycle, The Economic Journal, Vol. 105, No. 432 (Sep., 1995), pp. 1145-1164

Ascari, G., & Sbordone, A. M. (2014). The Macroeconomics of Trend Inflation. Journal of Economic Literature, 52(3), 679–739.

Barrell, R., Delannoy, A., & Holland, D. (2011). THE IMPACT OF HIGH OIL PRICES ON THE ECONOMY. National Institute Economic Review, (217), F68–F74.

Baumeister, C., & Kilian, L. (2016). Forty Years of Oil Price Fluctuations: Why the Price of Oil May Still Surprise Us. The Journal of Economic Perspectives, 30(1), 139–160.

van den Brakel, J, Söhler, E., Daas, P., Buelens, B. (2016), Social media as a data source for official statistics; the Dutch Consumer Confidence Index.

Bry Boschan (1971) - Cyclical Analysis of Time Series: Selected Procedures and Computer Programs, pp. 21.

Bikker (1993) - A leading indicator of inflation for the Netherlands. Quarterly Bulletin, (1993), pp. 43-57. No. 3 (December), De Nederlandsche Bank.

Bikker & Kennedy (1999) - Composite leading indicators of underlying inflation for seven EU countries. Journal of Forecasting. J. Forecast. 18, 225±258 (1999)

CBS. (2017, October 5). Inflatie loopt licht op. Retrieved from https://www.cbs.nl/nl-nl/achtergrond/2017/40/inflatie-loopt-licht-op

Cechetti (2000) - The Unreliability of Inflation Indicators. Current issues in economics and finance. April 2000. Volume 6 number 4.

ECB (2011). The Monetary Policy of the ECB, 3rd edition. European Central Bank, Frankfurt am Main.

Engle, R. F., Granger, C. W. J. (1987) Co-integration and error correction: Representation, estimation and testing. Econometrica, 55(2): 251-276.

Faust, J., & Wright, J. H. (2013). Forecasting Inflation. In Handbook of Economic Forecasting (Vol. 2, pp. 2–56). Elsevier. https://doi.org/10.1016/B978-0-444-53683-9.00001-3

Flanagan, R. J. (1999). Macroeconomic Performance and Collective Bargaining: An International Perspective. Journal of Economic Literature, 37(3), 1150–1175. https://doi.org/10.1257/jel.37.3.1150

Garner (1995) - How useful are leading indicators of inflation?

Gokmenoglu, K., Azin, V., & Taspinar, N. (2015). The Relationship between Industrial Production, GDP, Inflation and Oil Price: The Case of Turkey. Procedia Economics and Finance, 25, 497–503. https://doi.org/10.1016/S2212-5671(15)00762-5

Graafland, J. J., & Huizinga, F. H. (1999). Taxes and Benefits in a Non-linear Wage Equation. De Economist, 147(1), 39–54. https://doi.org/10.1023/A:1003542108657

Hunt, B., Isard, P., & Laxton, D. (2002). THE MACROECONOMIC EFFECTS OF HIGHER OIL PRICES. National Institute Economic Review, (179), 87–103.

Jones, D. W., Leiby, P. N., & Paik, I. K. (2004). Oil Price Shocks and the Macroeconomy: What Has Been Learned Since 1996. The Energy Journal, 25(2), 1–32.

Kazemier, B., Zeelenberg, C., and Walschots J., 2017 - Monitoring inflation, CBS.

Kilian, L. (2008a). A Comparison of the Effects of Exogenous Oil Supply Shocks on - Output and Inflation in the G7 Countries. Journal of the European Economic Association, 6(1), 78–121.

Kilian, L. (2008b). The Economic Effects of Energy Price Shocks. Journal of Economic Literature, 46(4), 871–909.

Lucas, R. E. (1996). Nobel Lecture: Monetary Neutrality. Journal of Political Economy, 104(4), 661–682.

Peeters, M., & den Reijer, A. (2014). Coordination versus flexibility in wage formation: a focus on the nominal wage impact of productivity in Germany, Greece, Ireland, Portugal, Spain and the United States. Applied Economics, 46(7), 698–714. https://doi.org/10.1080/00036846.2013.851773

Peri, G. (2016). Immigrants, Productivity, and Labor Markets. The Journal of Economic Perspectives, 30(4), 3–29. https://doi.org/10.1257/jep.30.4.3

Reijer, A. D., & Vlaar, P. (2006). Forecasting Inflation: An Art as Well as a Science! De Economist, 154(1), 19–40. https://doi.org/10.1007/s10645-006-0002-2

Roth (1986) - Leading indicators of inflation. Federal Reserve Bank of Kansas City Economic Review, November, pp. 3-20.

Seitz (1998) - An Index of Leading Indicators on Inflationary Trends and the Business Cycle.

Appendix

Literature on leading indicators for inflation

For this research literature about predicting inflation[12] is relevant, because it describes how to find leading or lagging indicators. All research we found on predicting inflation use consumer prices similar to the consumer price index (CPI) as measure of inflation. The commonly used method to predict CPI is to find leading indicators. Predicting the exact value of CPI turns out to be very difficult. However, detecting turning points is shown to be possible by using a combination of leading indicators. Especially relevant for this research is the question which economic indicators were found to be important in predicting the CPI.

Roth (1986) examines the use of five leading inflation indicators. He finds that the composite indexes have been better at predicting turning points, though with varying lead times. He uses the composite indexes defined by Moore, Niemira and Morosani. Bikker (1993) analyses the behaviour of inflation in the Netherlands. To predict movements in inflation he transforms the data to represent changes in the deviation from the long term trend and calls this the 'deviation cycle'. This is an extra step that we have not seen in other papers on inflation indicators. He finds that the most relevant indicators are share prices, price levels of imported raw materials, world market commodity prices and long-term interest rate in Germany. Combining these indicators leads to a leading indicator that can predict turning points in inflation. Garner (1995) investigates five widely used existing indicators for inflation and shows they are useful in predicting turning points. Though he notes that the indicators have signalled turning points with varying lead times and have sometimes given false signals. He argues that "the empirical evidence provides only qualified support for the leading indicators of inflation, financial market participants and policy makers should probably use a variety of economic models and indicators to predict CPI inflation". Artis et al. (1995) investigates leading indicators for the UK. He finds that troughs are more difficult to predict than peaks, also because inflation falls 50% faster than that it rises. He finds that the optimal set of short term indicators are M0, import unit values and unemployment. The optimal set of long term indicators are vacancies, retail sales volume, index of industrial production and world commodity prices. Seitz (1998) investigates which indicators have been important in predicting CPI in the past and finds that this varied a lot. Therefore he proposes a method of constantly revising a set of five leading indicators. He finds that in the seventies and mid to late eighties there is no single dominant variable. Indicators that are proven most relevant in his studies are the monetary aggregates (M1, M2, M3). In the nineties the capital and money market rates, commodity prices, index of share prices and M3 are included in the leading indicator. Furthermore, he finds that price trends at the preliminary stages (producer and import prices) tend to be of minor

[12] There are numerous articles written about inflation. Especially in the eighties inflation was a heavily researched topic, because inflation was problematically high. The interest for inflation seems to have diminished over the recent years, looking at the decreasing number of papers on the topic.

importance. He also stresses that the leading indicators are not suited for a point forecast of inflation, but hold valuable information for analysing turning points. Cechetti et al. (2000) extends the research of Garner (1995) in showing that there is still no indicator that clearly and consistently improves a forecasting model for CPI that includes lagged values of CPI as well. He concludes that not too much confidence should be put in CPI forecasts based on one indicator.

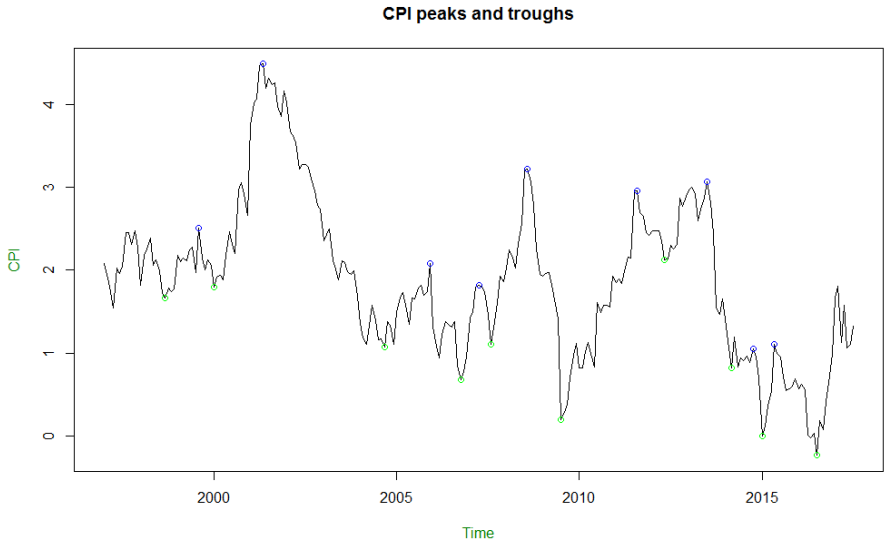
Correlation table

	CPI	CPI energy	CPI industrial goods	CPI food	CPI services	AEX	3-months interest	Gold price	10-year interest
CPI	1 (0)								
CPI energy	0.59 (-3)	1 (0)							
CPI industrial goods	0.53 (1)	0.26 (-12)	1 (0)						
CPI food	0.66 (3)	0.55 (9)	0.39 (-4)	1 (0)					
CPI services	0.61 (16)	0.32 (20)	0.61 (13)	0.43 (15)	1 (0)				
AEX	-0.41 (9)	-0.32 (-13)	-0.33 (20)	-0.33 (2)	-0.49 (-1)	1 (0)			
3-months interest	0.54 (4)	0.49 (11)	0.21 (20)	0.43 (-1)	0.54 (-14)	-0.29 (-3)	1 (0)		
Gold price	0.18 (-9)	0.28 (4)	-0.31 (4)	-0.21 (20)	-0.3 (10)	0.11 (8)	0.18 (0)	1 (0)	
10-year interest	0.48 (11)	0.42 (16)	0.28 (20)	0.26 (12)	0.45 (-6)	-0.2 (-17)	0.88 (0)	0.18 (-19)	1 (0)
Import industrial products	0.38 (-1)	0.67 (2)	-0.28 (4)	-0.4 (9)	0.17 (-20)	0.45 (4)	0.19 (-12)	0.3 (3)	0.17 (-14)
Wages	0.59 (12)	0.26 (-5)	0.55 (12)	0.32 (8)	0.74 (-6)	-0.4 (-2)	0.76 (3)	-0.2 (13)	0.71 (0)
Crude oil price	0.36 (-16)	0.73 (-2)	0.22 (-19)	-0.47 (2)	0.15 (11)	-0.36 (11)	0.33 (-15)	0.36 (-8)	0.28 (20)
Output price industry	0.45 (-3)	0.81 (0)	-0.17 (2)	-0.48 (6)	0.15 (-20)	0.34 (2)	0.38 (-12)	0.37 (-6)	0.27 (-16)
Privately owned houses	0.5 (-17)	0.24 (-13)	0.53 (-11)	0.32 (-18)	0.65 (-20)	-0.29 (-18)	0.7 (-16)	-0.45 (20)	0.63 (-20)
New build houses	0.47 (-2)	0.18 (-8)	0.41 (13)	0.42 (-2)	0.56 (-17)	-0.32 (-12)	0.59 (-9)	0.15 (-16)	0.56 (-12)
Capital goods	-0.35 (13)	0.43 (3)	-0.24 (6)	-0.42 (10)	-0.33 (13)	0.35 (9)	0.23 (-4)	0.47 (3)	0.16 (-15)
Import price machinery	-0.34 (15)	-0.25 (-3)	-0.29 (16)	-0.22 (15)	-0.46 (14)	0.18 (-6)	-0.34 (-9)	0.26 (3)	-0.38 (-20)

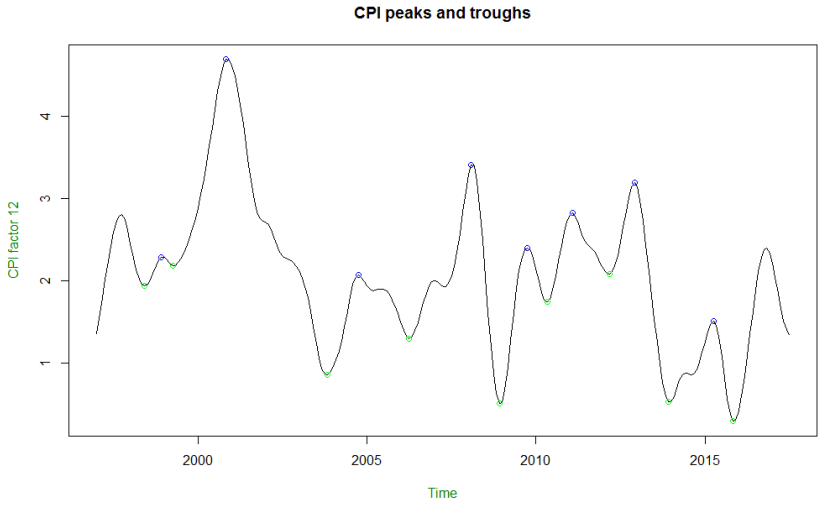
	Import industrial products	Wages	Crude oil price	Output price industry	Privately owned houses	New build houses	Capital goods producer price	Import price machinery
CPI								
CPI energy								
CPI industrial goods								
CPI food								
CPI services								
AEX								
3-months interest								
Gold price								
10-year interest								
Import industrial products	1 (0)							
Wages	-0.21 (-10)	1 (0)						
Crude oil price	0.62 (-4)	0.24 (20)	1 (0)					
Output price industry	0.78 (-1)	0.18 (20)	0.83 (2)	1 (0)				
Privately owned houses	-0.27 (-11)	0.85 (-18)	-0.22 (20)	-0.28 (17)	1 (0)			
New build houses	-0.35 (-15)	0.62 (-7)	0.16 (-20)	0.15 (10)	0.6 (7)	1 (0)		
Capital goods	0.71 (1)	-0.2 (15)	0.51 (7)	0.56 (4)	0.22 (3)	0.2 (-2)	1 (0)	
Import price machinery	-0.34 (-10)	-0.4 (20)	-0.32 (0)	-0.33 (-1)	-0.34 (-4)	-0.41 (-9)	0.53 (2)	1 (0)

Analysis for different data format

Peaks and troughs using year-on-year CPI changes.



Peaks and troughs using trend month-on-month CPI seasonally adjusted.



Linking turning points

Linking peaks and troughs between crude oil price and CPI.

Peak crude oil	Peak CPI	Lead time
9	10	1
-	24	-
30	47	17
63	-	-
83	94	11
102	-	-
128	134	6
151	154	3
168	170	2

179	-	-
189	192	3
201	220	19
236	239	3

Trough crude oil	Trough CPI	Lead time
17	18	1
-	28	-
54	-	-
75	83	8
92	-	-
-	112	-
115	-	-
142	144	2
161	161	0
175	183	8
186	-	-
195	204	9
215	227	12

Linking peaks and troughs between CPI and wages.

Peak wages	Peak CPI	Lead time
-	10	-
-	24	-
32	47	15
49	-	-
65	-	-
-	94	-
96	-	-
109	-	-
127	134	7
138	154	16
167	170	3
184	192	8
213	220	7
230	239	9

Trough wages	Trough CPI	Lead time
-	18	-
-	28	-
39	-	-
58	-	-

-	83	-
91	-	-
101	112	11
118	-	-
132	144	12
160	161	1
173	183	10
196	204	8
221	227	6
240	-	-

Linking peaks and troughs between CPI and import industrial goods

Peak import industrial goods	Peak CPI	Lead time
	10	-
	24	-
43	47	4
53	-	-
62	-	-
71	-	-
90	94	4
106	-	-
-	134	-
138	154	16
159	-	-
169	170	1
180	192	12
200	-	-
219	220	1
239	239	0

Trough industrial goods	Trough CPI	Lead time
	18	-
	28	-
49	-	-
57	-	-
66	-	-
76	83	7
96	112	16
114	-	-

-	144	-
146	161	15
165	-	-
175	183	8
193	204	11
205	-	-
-	227	-
229	-	-

Linking peaks and troughs between CPI and capital goods produced in the Netherlands

Peak capital goods	Peak CPI	Lead time
-	10	-
15	24	9
40	47	7
69	-	-
91	94	3
114	-	-
-	134	-
138	154	16
159	170	11
179	192	13
215	220	5
237	239	2

Trough capital goods	Trough CPI	Lead time
-	18	-
22	28	6
54	-	-
79	83	4
107	112	5
125	-	-
-	144	-
149	161	12
169	183	14
202	204	2
227	227	0

Linking peaks and troughs between CPI and import machinery.

Peak import	Peak CPI	Lead time

machinery		
-	10	-
-	24	-
-	47	-
-	94	-
102	-	-
126	134	8
143	154	11
159	170	11
178	192	13
195	-	-
217	220	-
234	239	5

Trough import machinery	Trough CPI	Lead time
-	18	-
-	28	-
-	83	-
-	112	-
132	144	12
151	161	10
169	183	14
190	204	14
207	-	-
-	227	-
229	-	

Explantion of symbols

Empty cell	Figure not applicable
.	Figure is unknown, insufficiently reliable or confidential
*	Provisional figure
**	Revised provisional figure
2017–2018	2017 to 2018 inclusive
2017/2018	Average for 2017 to 2018 inclusive
2017/'18	Crop year, financial year, school year, etc., beginning in 2017 and ending in 2018
2015/'16–2017/'18	Crop year, financial year, etc., 2015/'16 to 2017/'18 inclusive

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

Colophon

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Information
Telephone +31 88 570 70 70, fax +31 70 337 59 94
Via contactform: www.cbsl.nl/information