

# Towards a monthly indicator of economic growth

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# Abstract

This paper describes the research carried out by Statistics Netherlands in developing a monthly indicator of economic growth. Although a lot of information on short-term economic movements is available on a monthly basis, a monthly overall measure of the state of the economy is still lacking. A monthly overall indicator gives a very timely and up-to-date picture of the economy and could be of great use in timely and correctly identifying turning points in the business cycle.

The newly developed indicator is built from the supply side of the economy, using structural information from the national accounts and monthly year-on-year volume growth rates for separate industries. For some sectors (industry, construction, mining and quarrying and energy and water supply), monthly source statistics on the output produced are available. Where monthly data are lacking, for example for commercial services, econometric techniques are used to arrive at a monthly series using quarterly data and additional indicator series that are available at a monthly frequency.

Real-time simulation over a number of years demonstrates that the monthly indicator performs quite well. Compared to the final year estimates of GDP volume growth, the monthly indicator has only a small downward bias. Other summary statistics (mean absolute revision, root mean square revision, maximum positive/negative revision) also show that the monthly indicator performs well, and in fact outperforms the official quarterly (flash and regular) estimates.

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# 1. Introduction

In the realm of short-term economic statistics, the ultimate challenge statisticians are facing is telling people today what happened yesterday, or, maybe even more ambitious, informing them how things presently are going in the economy. The fact that this can never completely be achieved does not mean that we should not strive to do so.

As a result of the crisis, improving timeliness of short-term economic statistics is prominently back on the r&d agenda, after a period in which the lack of accuracy of early estimates of, for example GDP volume growth, was the main concern. Statistics Netherlands is presently investigating the possibilities of increasing the timeliness of the first quarterly GDP estimate from t+45 days to t+30 days and participating in a newly created Eurostat Task Force that will assess the feasibility of producing a flash estimate of the euro area and EU GDP quarterly growth rate at t+30 days. See Eurostat (2013) for the background of this initiative.

Up to now, a feasibility study has been carried out by Statistics Netherlands including drawing up an inventory of all sources and their timeliness, examining the loss of source coverage in case of an acceleration from t+45 to t+30 and identifying data gaps. Using the same methodology that is used for the official flash and later (regular) estimates, test runs were performed for the four reporting quarters of 2011. While the results of these test runs were encouraging, it was generally felt that there was a need for further improvement, and based on the experiences so far and the lessons learned from these exercises, the project will be continued in 2013/2014 with some additional testing periods (Rensman, 2012).

Increasing the timeliness of flash GDP from t+45 to t+30 would be quite an achievement. But even if we succeed in realizing this, it would still mean that, on average, the latest figure is lagging four months behind.<sup>4</sup> A very effective way of increasing timeliness is increasing the periodicity. If we were able to compile GDP estimates on a monthly basis at t+45, the average lag would be reduced by two months. For this reason, and also because a lot of information that is used for compiling quarterly GDP is also available on a monthly basis, Statistics Netherlands has been exploring the possibilities of compiling GDP at a monthly basis as well.

There are other reasons why it would be worthwhile to investigate the possibilities of producing monthly estimates of GDP volume growth. High frequency series can be of great use in timely and correctly identifying turning points in the business cycle. And as Cuhe and Hess (2000) point out, for economic studies using quarterly data, a low number of observations can cause serious flaws in the quality of quantitative analysis. In the absence of monthly GDP series, economists are sometimes forced to use variables that proxy GDP and that are available at a higher frequency. Mitchell et al. (2005) use similar arguments to advocate the compilation of monthly GDP estimates: "In many countries including the UK monetary policy is set more frequently than quarterly and in order to do so policy makers need not only to anticipate first estimates of GDP growth but also to estimate what is happening within each quarter. A range of monthly series is currently available giving indications of short-term movements in output. As the only available information, they are already exploited in various ways: financial commentators routinely examine monthly data on retail sales, the trade figures, and the

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<sup>4</sup> This can be illustrated by an example. The estimate for the fourth quarter refers on average to November 15<sup>th</sup>. Presently, the estimate is published on February 15<sup>th</sup> (t+45). The estimate of the following quarter is published on May 15<sup>th</sup>. Halfway through the period between these two publication dates, on April 1<sup>st</sup>, the most recent estimate describes the situation of, on average, 4½ months earlier. Going from t+45 to t+30 would reduce the average lag from 4½ months to 4 months.

output of the production industries in order to assess the state of the economy and likely developments in monetary policy; academic researchers exploiting high frequency econometric techniques make use of one or the other series as the best available proxy for a broader measure of demand or output". And they continue: "If these monthly data are to be used to draw inferences about the state of the economy as a whole, then it is desirable that there should be some formal procedure for grossing them up to represent the whole of GDP. Such a procedure is likely to produce estimates of GDP which are worse than those which might be produced by direct measurement. On the other hand, it would certainly be more satisfactory than simply making an informal inference from whatever happen to be the latest numbers available" (Mitchell et al., 2005, F108-F109).

This paper describes the research carried out by Statistics Netherlands in developing a monthly volume indicator of GDP, or, as we have named it, a monthly indicator of economic growth. It is good to point out that we are not the first to try and develop a measure of monthly GDP. Earlier studies that come to mind are Cuhe & Hess (2000) and Mitchell et al. (2005). Several institutes actually compile and publish monthly GDP or some proxy, for example Statistics Canada (the first publication of Canadian monthly GDP was released in 1971, see Girard, 2009), Statistics Finland with the so-called Trend Indicator of Output, before September 2005 known as Monthly Indicator of GDP (see Statistics Finland, 2009 and Hakala et al., 2011) and the Macroeconomic Advisers' Measure of Monthly GDP for the USA (Macroeconomic Advisers, 2008). We are quite confident that this list is far from exhaustive.

Paragraph 2 describes the methodology behind the newly developed indicator. As is the case with many rapid estimates, the monthly indicator is partly based on direct measurement and partly based on nowcasting, for those areas where basic source data are lacking. Paragraph 3 shows the results of real-time simulations over the period 2005-present. Paragraph 4 presents miscellaneous issues such as month-to-month changes, seasonal adjustment and benchmarking the series to quarterly flash GDP. Paragraph 5 contains some concluding thoughts.

## 2. Methodology

Basically, there are three ways to estimate GDP: the production approach, the expenditure approach and the income approach. In the Netherlands, all estimates of GDP, including the quarterly flash estimate, are made according to the production approach as well as the expenditure approach. Supply and use tables are the balancing framework, in which differences between supply and demand are resolved by evaluating the relative reliability of the basic data. Because of a lack of detailed information in the short term, the quarterly accounts are more aggregated than the annual accounts. In addition, the monthly and quarterly data sources are incomplete in the sense that they do not provide all the necessary information on outputs and intermediate consumption. For example, intermediate consumption is estimated on the assumption that the ratio between the volume of production and the volume of intermediate consumption is constant in the short term. However, this assumption is relaxed in the balancing process. When source data are generally lacking, proxies and/or expert guesses are used to arrive at an early estimate. Using the production approach as well as the expenditure approach does not mean that both approaches are entirely independent: to a large extent, the same basic data are used. The estimation of some expenditure components (household final consumption, investment) is based on the supply side, as there is no short term budget survey amongst households and no monthly or quarterly survey on capital expenditure. See Tanriseven (ed.), 2005 for a detailed description of the methods and sources used.

When we started exploring the possibilities of compiling GDP on a monthly basis, we quickly decided that the approach used in the other (quarterly and yearly) estimates was not an option, due to the fact that this approach is rather costly in terms of the production capacity needed. The idea was therefore to search for an approach that would take little production time and would at the same time enable us to produce sufficiently reliable outcomes at the level of total GDP. An additional requirement was that the method should be based on existing information, as the setting up of new surveys was not an option, given the drive to reduce the administrative burden on the private sector.

Basically, the approach chosen is rather simple. We build an estimate of monthly GDP volume growth from the supply side, using structural information from the national accounts and monthly year-on-year volume growth rates for separate industries. Year-on-year volume change of total value added is then compiled as the summation of the weighted growth rates of the separate components, using the value shares of the corresponding quarter of the previous year of each industry as weighting factors. Next, total value added is converted from basic prices to market prices. Here we use the value of individual taxes and subsidies of the corresponding quarter in the previous year, multiplied by the growth rates of (mostly consumption related) activities associated with the individual taxes and subsidies<sup>5</sup>.

The remaining issue is then, how to derive the monthly year-on-year volume growth rates for separate industries. For some economic sectors (industry, construction, mining and quarrying and energy and water supply), we have good and reliable monthly statistics on the output produced. For some other sectors, particularly the commercial services sector, which is quite important in the Dutch economy, monthly statistics on sales, output and prices are to a large

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<sup>5</sup> GDP volume growth according to the expenditure approach could in principle be estimated in a similar way. In the first phase of the project, this was tried, but with not very successful results. Particularly the estimation of changes in inventories proved to be a problem. In the absence of short-term source information on inventories, we were unable to find a suitable alternative estimation procedure. It should be noted that this is also a problem in the quarterly estimates, where changes in inventories are used as a balancing item.

extent lacking. This problem is not unique for monthly GDP: the information set for the official quarterly GDP estimates (the flash estimate in particular) is incomplete as well. To fill in data gaps, different techniques were employed for different industries, ranging from using rather basic time series models (for agriculture, forestry and fishing), to more sophisticated models.

For commercial services, a very important sector in the Netherlands, we employed a Chow-Lin model for temporal disaggregation and extrapolation using indicator series that are available on a monthly basis<sup>6</sup>. Out of a set of 47 candidates – indicators that are available on a monthly and timely basis, that are available over a sufficiently long time period (this was set to 15 years) to enable us to thoroughly analyse and test their performance and that have a logical relationship with the series to be estimated – we finally decided for 4 indicators: domestic household consumption (year-on-year volume growth), economic climate (a component indicator of consumer confidence, seasonally adjusted), number of bankruptcies of single-owner companies and trading partnerships (year-on-year change, two months average) and the assessment order position of manufacture of intermediate goods (a component indicator of the Netherlands Business Survey).

Out-of-sample estimates over the period 2005-2010Q2 show that the Chow-Lin model for commercial services performs quite well. When we compare the outcomes on a quarterly basis<sup>7</sup> with the best available official quarterly data, the Chow-Lin model clearly outperforms the (often used) basic technique where the last available (quarterly) observation is replicated, in terms of root mean square error, mean absolute error, maximum error and bias. This may not come as a surprise. Especially when turning points occur, the Chow-Lin method performs clearly better. More surprisingly, the Chow-Lin estimates also outperform the estimates for commercial services in the official flash and regular quarterly GDP estimates.

Some time was devoted to investigate whether we could get even better results by modelling separate industries within the commercial services sector, but this did not result in a significant improvement.

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<sup>6</sup> Chow and Lin (1971) were the first to present a coherent and easily applicable econometric approach that handles interpolation problems for stock and flow variables. Assuming a linear relation between the series of interest (series for which observations are missing, i.e. a monthly GDP) and other data with more frequent recording (related series), they estimate a univariate regression equation.

<sup>7</sup> There is no monthly reference series available to compare the outcomes with. To get an idea of the performance, we therefore compare the estimates on a quarterly basis with the quarterly data on commercial services from national accounts.



### 3. Results

In order to test the method and to get an idea about the reliability of the outcomes, real-time simulations were performed over the period 2005 – present. For this purpose, a dataset of historical real-time statistics was used. These are the source data as they would have been known around 45 days after the end of the reporting month. Adjustments or improvements that were made to the data after those 45 days were disregarded. This made it possible to perform a realistic simulation of the method with a starting point in 2005.

To test the accuracy, the estimates are compared with results from the quarterly national accounts. The results of the monthly indicator are converted to quarterly figures by calculating an unweighted average of the corresponding three months.

**Figure 1. Monthly Indicator of Economic growth compared to quarterly flash GDP, real-time series, year-on-year volume changes, 2005-2013 2<sup>nd</sup> quarter**

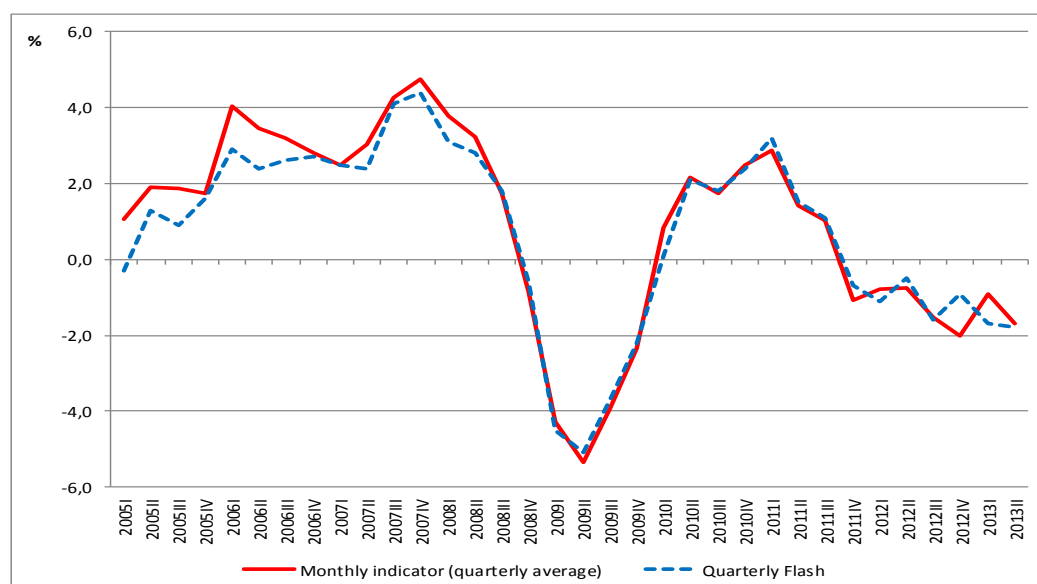
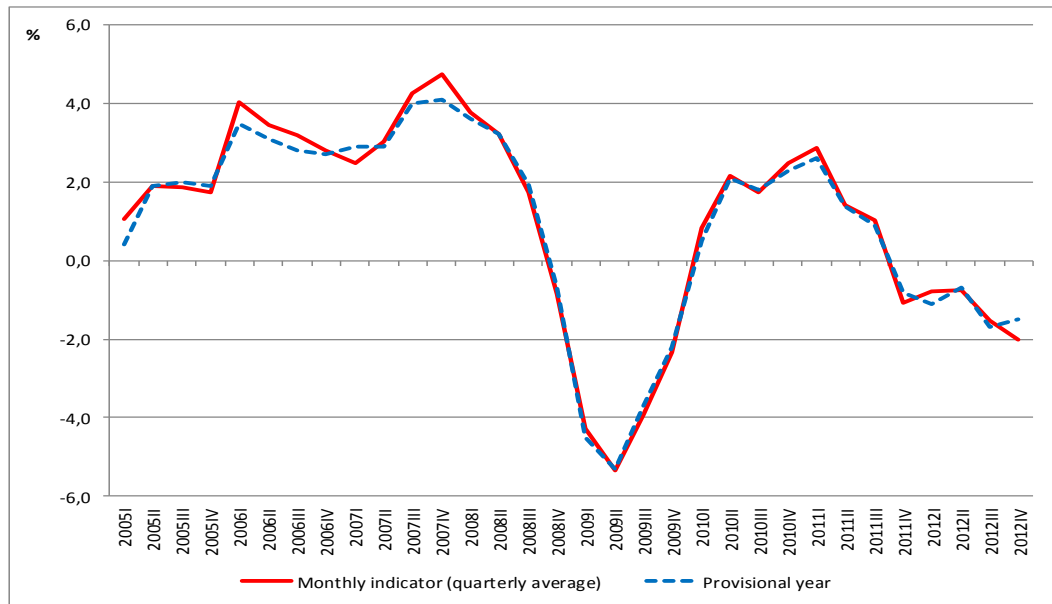


Figure 1 compares the newly constructed indicator to the quarterly flash GDP. On the whole, the pattern is quite similar, the biggest differences in level occurring in 2005 and 2006, when the monthly indicator was on average higher than the flash. However, it should be pointed out that the official GDP estimates for this particular period were afterwards significantly revised upwards.

Figure 2 shows the monthly indicator in comparison to the provisional year estimates. We see that the monthly indicator is much closer to these series in the first two years. Likewise, the difference between monthly indicator and provisional year estimate in the 4<sup>th</sup> quarter of 2012 is much smaller than the difference between monthly indicator and flash.

**Figure 2. Monthly Indicator of Economic growth compared to quarterly GDP (provisional year), real-time series, year-on-year volume changes, 2005-2012**



**Table 1. Monthly indicator compared to flash GDP, regular quarterly GDP, provisional year (2005-2012) and final year estimate (2005-2010)**

| Summary statistic         | Flash | Regular quarterly estimate | Provisional year | Final year |
|---------------------------|-------|----------------------------|------------------|------------|
| Mean revision             | -0.20 | -0.14                      | -0.08            | 0.09       |
| Mean absolute revision    | 0.40  | 0.32                       | 0.24             | 0.29       |
| RMSR                      | 0.54  | 0.47                       | 0.29             | 0.36       |
| Maximum positive revision | 1.1   | 0.8                        | 0.5              | 0.7        |
| Maximum negative revision | 1.4   | 1.6                        | 0.7              | 0.5        |

Table 1 shows some summary statistics on the differences between the monthly indicator and consecutive estimates of quarterly GDP volume growth. The mean revision  $MR = \frac{\sum_{t=1}^n (L_t - P_t)}{n}$ ,

with  $L_t$  = later estimate,  $P_t$  = earlier estimate,  $n$  = nr. of observations; the mean absolute revision  $MAR = \frac{\sum_{t=1}^n |L_t - P_t|}{n}$ ; the root mean square revision  $RMSR = \sqrt{\frac{\sum_{t=1}^n (L_t - P_t)^2}{n}}$ .

Compared to the flash, the mean revision has a negative sign, indicating that, on average, the monthly indicator overestimates the flash. Compared to later estimates, the mean revision (or bias) becomes smaller, and finally turning into a small negative bias compared to the final estimates. The mean revision between monthly indicator and later provisional estimates becomes much smaller, if we leave 2005 and the first half of 2006 aside, taking into account that the early estimates were significantly downward biased in the period before the second

half of 2006, due to methodological shortcomings, and improvements have been made since<sup>8</sup>. The mean revision reduces to -0.08 (compared to the flash), -0.03 (regular estimate), resp. -0.05 (provisional year). The mean revision compared to the final estimate reduces to 0.05, indicating a small downward bias of the monthly indicator.

Table 2 shows summary statistics for different provisional estimates compared to the final estimate. The monthly indicator performs quite well in comparison to the quarterly flash, the regular quarterly estimate and the provisional year estimate. The bias is significantly smaller, which is remarkable when we realize that the monthly indicator uses mostly the same source data as the official quarterly estimates. Mean absolute revision and RMSR for the monthly indicator compare favourably to the outcomes for the official provisional estimates as well. This picture does not change if we restrict our analysis to 2006Q3 – 2010.

**Table 2. Monthly indicator, flash GDP, regular quarterly GDP and provisional year compared to the final year estimate, 2005-2010 (2006Q3-2010)**

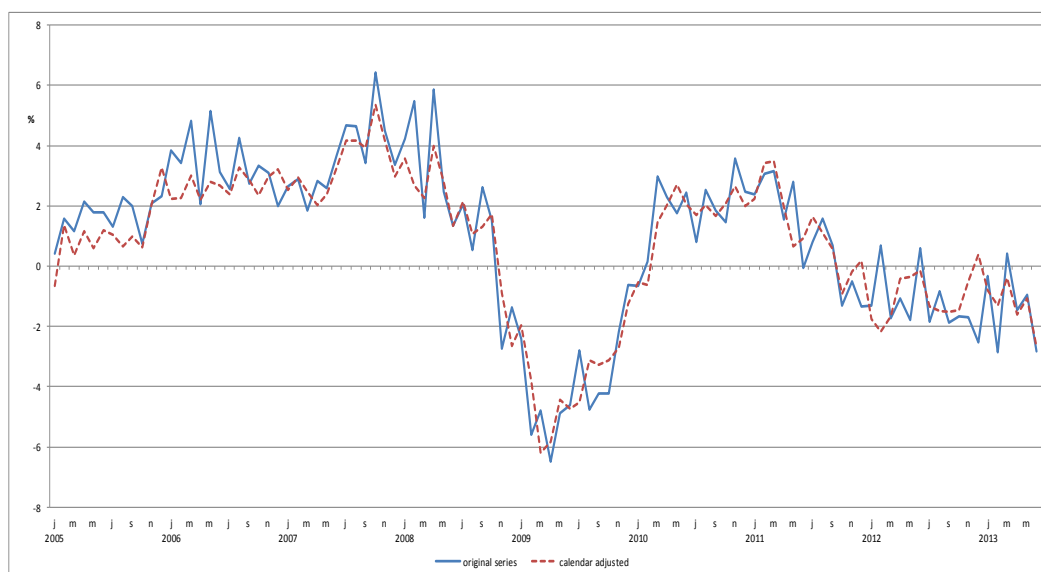
| Summary statistic             | Monthly indicator | Flash       | Regular quarterly estimate | Provisional year |
|-------------------------------|-------------------|-------------|----------------------------|------------------|
| Mean revision                 | 0.09              | 0.44        | 0.36                       | 0.20             |
| Mean absolute revision        | 0.29              | 0.52        | 0.49                       | 0.32             |
| RMSR                          | 0.36              | 0.66        | 0.61                       | 0.37             |
| Maximum positive revision     | 0.7               | 1.7         | 1.5                        | 0.7              |
| Maximum negative revision     | 0.5               | 0.3         | 0.3                        | 0.3              |
| <b>2006Q3-2010</b>            |                   |             |                            |                  |
| <i>Mean revision</i>          | <i>0.05</i>       | <i>0.22</i> | <i>0.15</i>                | <i>0.12</i>      |
| <i>Mean absolute revision</i> | <i>0.27</i>       | <i>0.33</i> | <i>0.32</i>                | <i>0.29</i>      |
| <i>RMSR</i>                   | <i>0.32</i>       | <i>0.39</i> | <i>0.37</i>                | <i>0.34</i>      |

<sup>8</sup> One of the shortcomings that were identified was, that the method used in different short-term economic source statistics insufficiently allowed for the effects of population dynamics, which resulted in underestimating economic growth when the economy was booming. As such, there will always be revisions, being the inevitable outcome of the trade-off between timeliness and accuracy, with early estimates based on incomplete data. Nevertheless, revisions should not be too large, early estimates should not give misleading impressions of underlying trends, and they should not have a significant bias. Revisions analysis can be a very useful tool in identifying areas in the statistical estimation and compilation process that need to be improved.

## 4. On benchmarking, trading day adjustment and seasonally adjusted month-to-month changes

Monthly year-on-year changes of the newly developed indicator are shown in figure 3. Contrary to the original series that was used in paragraph 3 in order to test its accuracy, the series used here is benchmarked to the official quarterly flash estimate, that is, the preliminary monthly estimates are aligned to the new quarterly estimates when they become available<sup>9</sup>. In this way, the monthly series is consistent with quarterly flash GDP.

**Figure 3. Monthly Indicator of Economic Growth, benchmarked series, year-on-year volume changes, 2005-June 2013**



It is immediately obvious that the monthly series shows a more volatile behaviour than the quarterly series. The month-to-month fluctuations are reinforced by trading day patterns. By taking into account the changing composition of weekdays, holidays, leap days and the distribution of summer holidays, a trading day adjusted series can be made. This series is also shown in figure 3. This series shows a somewhat less volatile pattern than the original series and provides a clearer picture of underlying economic trends. However, the trading day adjusted series inevitably exhibits some volatility as well, which is a feature inherent to high frequency economic series in general, where irregular variations due to different phenomena, such as the weather or tax measures, can significantly affect the outcomes.

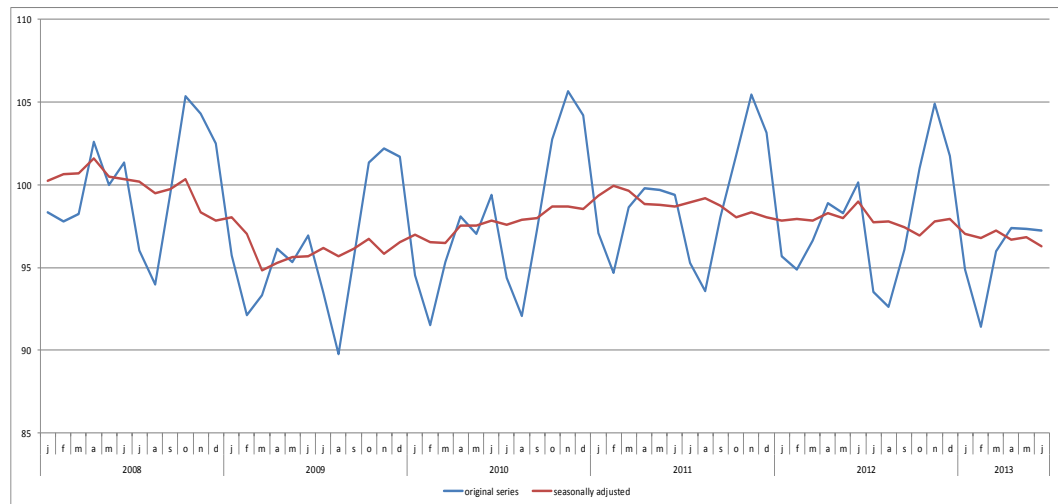
Figure 4 shows the monthly indicator expressed as an index series (2008=100). The index series shows a strong seasonal pattern. Figure 4 shows a seasonally adjusted series as well. Seasonal adjustment of monthly GDP was performed at the most aggregated level, using X-12-ARIMA. The seasonally adjusted series can be used to compile month-to-month changes of economic growth, which should enable us to get a more timely picture of the state of the economy and to identify turning points more quickly. Month-to-month changes of the seasonally adjusted series are shown in figure 5. The rather volatile character of this series is quite obvious from the graph, which is no surprise, as other monthly economic series, for example the industrial production index or foreign trade statistics, show a similar pattern. This, of course, complicates

<sup>9</sup> Here, we use the Chow-Lin (1971) method as well.

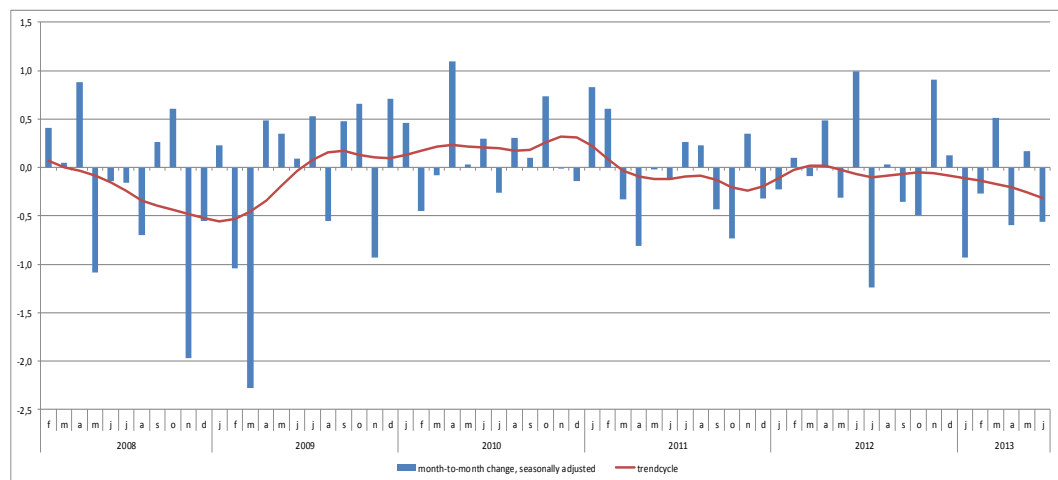
the interpretation of the movement of the series. Month-to-month changes of the trendcycle, where seasonal and trading day effects, as well as noise have been removed, also shown in figure 5, give a more discernible picture of what is going on in the economy, while it for example requires some imagination to detect a turning point at the beginning of 2009 using the month-to-month seasonally adjusted series.

Even in periods of moderate economic growth, the month-to-month seasonally adjusted series shows a negative outcome every three or four months, which makes it difficult, if not impossible, to draw conclusions from a single figure. Analysis of the outcomes should preferably be done in context with the history of the series and in connexion with related statistics. To carefully interpret and present the outcomes requires some effort from the side of the producer, in order to prevent confusion among the users. But this goes without saying. Of course, one could also decide to present the outcomes in the form of a two- or three-month moving average or to use a more sophisticated technique to get a less erratic pattern.

**Figure 4. Monthly indicator of economic growth, original series, seasonally adjusted series, index (2008=100)**



**Figure 5. Monthly indicator of economic growth, seasonally adjusted, month-to-month changes and trendcycle, month-to-month changes.**



## 5. Concluding thoughts

In order to put things a little bit into perspective, let us start with a well-known quote on GNP/GDP. In March 1968, Robert F. Kennedy addressed the audience at Kansas University with the following words: *"Yet the gross national product does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country, it measures everything in short, except that which makes life worthwhile."*

There he was right, of course, although some might argue that it was easy for him to talk like that, most likely being in a comfortable position not having to worry about how to pay the mortgage and for all other daily necessities. It does not mean that GDP does not matter, but one cannot help feeling that the outside world is sometimes exaggerating its importance and is inclined to overreacting to a rise or fall. In a sense, GDP is overworked: one cannot expect one single statistic answering the question, how well we are off, and if things are getting better or worse (if at all). A Dutch economic journalist recently made an appeal to ignore GDP altogether, based on the observation that, when Dutch GDP performed a little bit worse than that of neighbouring countries for a short while, immediately code orange was given by media and politicians in front. And he continued assuming that it would not take long before statisticians were able to compile GDP on a monthly, or even weekly basis (if he only knew!), which would make matters even worse<sup>10</sup>.

Because there seems to be a tendency towards over-reaction to statistical outcomes and because of the danger of interpreting the outcomes incorrectly, some may feel hesitant whether it is desirable to have a monthly GDP. Monthly statistics are inherently more volatile than quarterly or yearly statistics, and carefully interpreting the outcomes is therefore not that easy, taking into account the margin of uncertainty around the outcomes and the fact they are influenced by many circumstances which may not always easily be quantified. It certainly requires some effort from the producers to inform the public what the outcomes mean, and maybe more importantly, what they do not mean.

Having said that, we feel that, based on the motivation given in the introduction, it is worthwhile compiling monthly GDP, provided that one is able to obtain sufficiently reliable results. Based on the real time simulation which we did for Dutch GDP, we conclude that it is possible to do so, in a relatively easy way, based on information that is already available on a monthly basis.

Nevertheless, there is one remaining issue. This concerns the estimation of value added volume growth for those areas where monthly source statistics are lacking, commercial services in particular. Although the Chow-Lin model for temporal disaggregation and extrapolation using indicator series that are available on a monthly basis performs remarkably well, there are some doubts whether a statistical office can produce a statistic that leans to such a large extent on an econometric model that does not use any directly measured information on the production in different services sectors in the reporting period. Some consider this exclusively the domain of research institutes or planning agencies and are of the opinion that a statistical office should base its output on directly measured source data. However, others point out that using a variety of model based approaches, for example a simple time series model where the last available observation is replicated, or an expert guess

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<sup>10</sup> De Waart, 2013.

(based on a model that the expert has in his head, with or without related indicators), or more sophisticated approaches, has been common practice in official statistics for a long time, this being the inevitable outcome of the ambition to meet the demand for timely and high frequent statistical information. Quarterly flash GDP is also a mix of measuring and nowcasting. The ambition to produce more timely or more frequent statistical information is at odds with the drive to reduce the administrative burden on the private sector, so the challenge is to find ways to meet both objectives. The question, how far a statistical office can go in placing a stronger accent on nowcasting, is a valid one. As Barcellan (2010) quite rightly observes: "The borderline (between the domain of research institutes and planning agencies on the one hand, and the domain of statistical offices on the other hand) is traced around nowcasts and flash estimates where a clear role for national statistical institutes is not fully evident".

The present position of Statistics Netherlands in this matter is that the newly developed monthly indicator places too strong an accent on nowcasting and that an attempt should be made to base the estimates for commercial services to a larger degree on variables that are more directly related to the output of the services sector. Business survey data, which have been available for services on a monthly basis starting from 2007, may be a candidate in this respect, and we recently started investigating the potential use of these data.

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