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QUALITY IMPROVEMENT OF THE DUTCH QUARTERLY FLASH: A TIME SERIES ANALYSIS OF SOME SERVICE INDUSTRIES*)

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Abstract

The Dutch Quarterly Flash (QF) is, just like the regular Quarterly Accounts (QA), a fully integrated statistic based on a quarterly updated input-output table. Not all short term statistics used to update the QA's IO-table are timely enough to be of use for the QF, so other sources have to be found or forecasts have to be made. In large parts of the service industry the latter is the only possibility. This paper reports on the use of econometric techniques (viz. series decomposition and ARIMA modelling) to improve the quality of the forecasts in five parts of the service industry.

Contents

1. Introduction

1.1. The Quarterly Flash and its Reliability

The Department of National Accounts of the Dutch Central Bureau of Statistics (CBS) is responsible for the compilation of macroeconomic statistics on the Dutch economy. The Quarterly Accounts (QA) - with a timeliness of about 17 weeks - were until recently the most timely fully integrated quarterly statistic. The QA provide information on 7 macroeconomic figures, viz.: Gross Domestic Product (GDP), Imports of Goods and Services, Consumption of Households, Consumption of Government, Gross Fixed Capital Formation by Enterprises, Gross Fixed Capital Formation by Government, and Exports of Goods and Services.

The QA are based on a fully balanced quarterly input-output table, compiled by extrapolating the input-output table of the same quarter in the previous year. This basic table determines the structure of production and demand. The extrapolation process for each sector in the table consists of applying four-quarter growth rates of values, volumes and prices ("trend indicators"), derived from basic statistical information. Moreover, additional ad hoc information is incorporated. The assumptions on the system's structure, the trend indicators and the additional ad hoc information are submitted to a balancing process, in which differences between "supply" and "demand" are reconciled.[1)]

A research project was started aiming at a more timely publication without giving in too much in terms of quality. The compilation process of these fast quarterly estimates, called Quarterly Flash (QF), should be exactly the same as that of the QA. It is clear, however, that the QF has to cope with a lack of basic statistical data. Therefore the QF project aims at providing trend indicators based on both available short-term indicators and econometric techniques, e.g. time series analysis. All in all, a timeliness of about 8 weeks for the fast estimate seemed possible.[2)]

Experimentally, the QF has been compiled since 1989-IV. Fast estimates have been made of four-quarter changes in volumes, prices, and values of the above mentioned seven macroeconomic aggregates. In this paper only the estimates of four-quarter volume changes are considered. In a recent paper the reliabilty of the QF estimates has been evaluated by comparing them to the regular QA figures.[3] The main conclusion was, that the QF estimates of GDP and both consumption categories were quite reliable estimates of the regular QA figures. The estimates of the other macroeconomic statistics were less reliable. Similar research had already led to the decision to publish the Flash estimate of GDP from the second quarter of 1991 on.

The rather poor reliability of some of the Flash estimates is related to lacking basic statistical information at the time the Flash figures are compiled. More timely basic statistics will lead to improvement of the preliminary results. Furthermore, time series techniques can be used whenever more timeliness is not possible. This paper reports on the use of time series analysis to generate more reliable timely estimates of output volume growth in some service industries.

1.2. Preliminary results for some service industries: Simple extrapolation, ARIMA modelling and their drawbacks

The service industry is divided by the CBS' Quarterly Accounts Subdivision in five parts:

- business services;
- social services;
- health and veterinary services;
- cultural and recreational services;
- other services.

The only timely quarterly statistic indicating real production growth in these industries is employment growth. However, it is not timely enough to be of use for the first quarterly estimates (the Quarterly Flash estimate), so forecasts have to be made. At first, a relatively simple "naïve" extrapolation method was used. The reliability of the results did not meet the usual standards. Research was started to improve the quality of the forecasts by means of univariate ARIMA modelling.

For each of these industries a quarterly time series of employed persons was available from 1976-I - 1991-I. For some periods the series had to be updated because of changing definitions. Whenever this was not possible the estimation period was adjusted to ensure homogeneity of the time series. The univariate ARIMA-models, which are shown in the appendix, yield much more reliable estimates than the naïve method. This judgement is based on the calculation of inequality coefficients, which compare the reliabity of two forecast methods by dividing their root mean square errors (the error is the difference between the forecasted and the actual value):

$$IC = \frac{\sqrt{\Sigma\ (R - F)^2}}{\sqrt{\Sigma\ (R - A)^2}}\ ,\ \text{where}$$

A, F, and R are expressed as four-quarter growth rates,
A = the flash estimate from the originally used "naïve" method,
F = the flash estimate from the ARIMA models,
R = regular Quarterly Accounts figure.

Here, an IC of less than 1 means that the ARIMA-models generate more reliable estimates than the originally used method. In fact, the inequality coefficients were 0.40 at most, which means a substantial improvement of the forecast quality.

It can, however, be argued that univariate ARIMA models do not necessarily provide us with the best forecasts. It is well known that the duration of the upswing and downswing periods of business cycles differ in time. For this reason, univariate ARIMA-models are not very well suited to describe, let alone forecast, the business cycle. Moreover, extensive literature in this field shows that seasonal ARIMA modelling often leads to problems of over-differencing.[4] This led us to the conclusion that further improvements of the results were possible and that this should involve separate modelling of cycle and season, and so the decomposition of the series in cyclical and/or seasonal movements.

1.3. Plan of the paper

This paper reports on the attempts to improve the ARIMA forecast results. As stated above, this involves the decomposition of the series. However, apart form the already mentioned cyclical and seasonal components, usually also the trend and the irregular components are distinguished. In formula:

Original series = Trend × Cycle × Season × Irregularities.[5)]

The difference between these components is intuitively clear: the trend is a long term movement determining the level of the series, the cycle is a more or less regular cyclical movement lasting a few years, the season is the more or less regular movement reoccuring each year, and the irregular component consists of a series of unrelated "shocks". By decomposing the series the components can be modeled separately, with the exception, of course, of the irregular component. But as statisticians often know when special events that influence their data have occured, they can adjust their figures accordingly.

To determine the seasonal and the irregular component, it was decided to apply Census II-X-11 method. X-11 is, also for the Dutch CBS, a commonly used seasonal decomposition method which also filters out the irregular component, and we had no reason to do the job otherwise. The removal of the irregular and the seasonal component results in a trend×cycle series, called "Henderson-series". In formula:

Henderson = Trend × Cycle, and

Original series = Henderson × Season × Irregularities.

Our research was based on this Henderson series. At first it was attempted to eliminate the Henderson's trend component (section 2.1) and to model the remaining cycle series (section 2.2). With models containing leading explanatory variables it should be possible to forecast changes in the cyclical movements. The figures of the Business Services were studied, because its output structure shows that this industry was most likely to be influenced by cyclical movements. If separate modelling of the cycle were possible, the cycle model forecasts, the trend model forecasts (which should be relatively simple to obtain), and X-11's predicted seasonal factors might be used to generate better quality forecasts. We did not succeed in establishing any causal relationship for the cycle. Subsequently we tried, as is shown in section 3, to model and forecast the Henderson series itself and to multiply the results by X-11's predicted seasonal factors. This led to a major improvement in the reliability of the forecasts. Section 4 contains some conclusions.

All time series models were estimated using Maximum Likelihood. Ordinary Least Squares was used to run some provisional regressions.

2. The Cyclical Component of Employment in the Business Services

The importance of isolating the cyclical component lies in the fact that its separate modelling becomes possible. To be more specific, we were looking for causal relationships in which the cyclical movements can be explained by other variables because univariate ARIMA models are inadequate in this respect. In section 2.1 several methods to remove the trend component from the Henderson series are discussed and one is chosen, while section 2.2 reports on the attempts made to model the thus derived cycle.

2.1. Derivation of the Cycle from the Henderson Series

To isolate the cycle from a trend×cycle series, a number of methods are available, notably:[6)]

1. the Method of Centred Moving Averages;
2. the Phase Average-Trend Method;
3. the Beveridge-Nelson or ARIMA approach.

ad 1. The Method of Centred Moving Averages.

This method eliminates the cyclical component from the Henderson series by calculating centred moving averages. Although it is a widely used method, it has two drawbacks. The first is, that centred moving avarages are two-sided filters: to calculate observation t of the trend series, observations from both the "past" (i.e. t-1, t-2, ..., t-n) and the "future" (i.e. t+1, t+2, ..., t+m) of the Henderson series are used. In this way it is simply impossible to calculate values for the trend series beyond a certain observation, and the trend series has to be extrapolated arbitrarily for a number of periods. As we have to forecast the series, this is a major drawback.

The second drawback is the fixed length of the filter. In order to calculate the trend series, the number of periods that is included in the moving average has to be equal to the average duration of the business cycle. In The Netherlands the average duration of a cycle has been estimated at 25 quarters. However, the actual duration of the business cycle shows great fluctuation.[7] Eliminating the cyclical component by computing moving averages over a fixed number of quarters will therefore lead to cyclical residuals in the trend series. The so-called phase average-trend method was developed by the National Bureau of Economic Research to deal with this problem.

ad 2. The Phase Average-Trend Method.

The method is based upon repeatedly calculating centred moving averages.[8] However, the resulting trend series is even shorter than that of the method of centred moving averages. Moreover, as Dutch research showed, the phase average-trend method does not lead to results that differ much from the results based on the simpler centred moving averages approach.[9] For these reasons the phase average-trend method was dropped here.

ad 3. The ARIMA Approach.

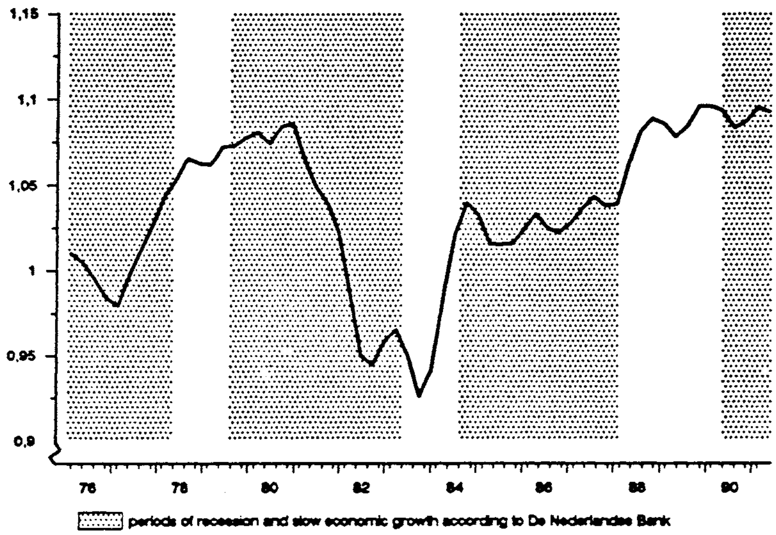
Beveridge and Nelson (1981) and Borsu-Bilande (1984) have developed another method to decompose a trend×cycle series in a cyclical and a trend component. A de-seasonalized ARIMA-model is used to describe the trend, the cycle is derived from its forecast errors. Mark that this is in line with the observation that fluctuating cycles cannot very well be caught in a univariate ARIMA model. Their procedure can be used for all series whose first differences are stationary, which is the case for most economic time series. Also in our case, the Henderson can be shown to be I(1).[10] For such series the procedure leads to a decomposition in:

a. a random walk with drift - the secular or trend component - and
b. a stationary cyclical component.

The procedure has the advantage that arbitrary extrapolation is not necessary: ARIMA-models are one-sided filters, i.e. only observations from the past are used.[11]

These considerations led to the conclusion that the cycle should be estimated using the method of centred moving averages or the ARIMA approach. The latter appears best suited for forecasting because less observations are lost at the end of the series. The resulting series is shown in figure 1. The shaded areas show the downswing and slow growth periods as indicated by the business cycle series of the Dutch Central Bank (De Nederlandsche Bank), which refers to industrial production growth.[12] As can be seen, the timing of both series does not coincide, but roughly speaking the same movements can be detected. Because developments in manufacturing industry are probably somewhat different from those in the service industry, we regarded our cycle series a plausible one.

Figure 1. Business cycle series of employment in the Business Services.



2.2. Forecasting changes in the Cycle

Subsequently, we have tried to model the thus derived cyclical component of the employment series in the Business Services in such a way that changes in the cyclical movements of employment growth can be predicted. As stated before, univariate ARIMA-models cannot very well do this. It is necessary to formulate and estimate models containing leading explanatory variables.

As an earlier CBS study has indicated, a number of indicators derived from the CBS business survey show a lead compared to the cyclical movements of industrial production.[13] The input-output table of the Dutch economy shows that a very large part of the Business Services output is sold to the manufacturing industries. So, a more or less corresponding cyclical pattern of production seemed plausible. This conclusion is in line with the results reported before. OLS-estimations were performed, using a number of different indicators as right hand variables, e.g. order books from the business survey and industrial production growth. This **invariably** resulted in very low values for the Durbin-Watson test statistic (DW). An example (t-values between brackets):

$$emp^c = \underset{(137)}{1.08} + \underset{(7.1)}{0.0025}\, ob_{-3}, \qquad (*)$$

with emp^c = cycle series of employment in the Business Services,
ob = opinion on industrial order books, quarterly averages.

$R^2adj = 0.47$ DW = 0.23 estimation period 1976-I/1991-I

The value of the Durbin-Watson test statistic indicates that (*) is not a valid specification.[14] In other words, the assumptions of the standard linear model are violated, which means that one cannot interprete the test statistics, e.g. the t-values, in the usual way. Further testing showed that both variables are I(1) and that (*) should be formulated in terms of first differences in stead of levels. However, re-estimation of (*) with first differences was not very succesful:

$$\Delta_1 emp^c = \underset{(0.91)}{0.0016} + \underset{(0.80)}{0.00053}\, \Delta_1 ob_{-3} \qquad (**)$$

$R^2adj = -0.00$ DW = 0.91 estimation period 1976-II/1991-I

As the value of the Durbin-Watson test statistic remains low, we tried to re-estimate (**) as a transfer model. These kind of models are used to formulate relationships with explanatory variables in the presence of autocorrelation. This was not succesful: whatever variable was used as explanatory variable, its t-value was close to zero. Only univariate ARIMA models seemed to adequately describe the cycle series. Moreover, as the Dickey-Fuller test indicated, even a random-walk specification of the series could not be rejected. At this point we concluded that we could not model the business cycle movements in such a way that cyclical changes can be predicted. And also, that there was no longer any reason to decompose the Henderson series.

3. Forecasting the Henderson

Subsequently, we tried to model the Henderson series itself. Even univariate ARIMA-models of this trend×cycle series should perform better than univariate ARIMA models for the original series. The reason for this is that the Henderson series was shown to be trend dominated. Moreover, the irregular and the seasonal components are removed from the series. This should lead to more stable models and no problems of overdifferencing with regard to seasonal patterns. So the Henderson series' ARIMA model was used to forecast, and Census II-X-11's predicted seasonal factors to update these forecasts. As a result the univariate ARIMA-models for the original series were clearly outperformed.

In short, the following three-step forecasting method was used:

1. a trend×cycle or Henderson series is computed using Census II-X-11;
2. an ARIMA-forecast is computed for the Henderson (if necessary, the series is differenced to ensure stationarity);[15)]
3. the forecasted value is multiplied by the predicted seasonal factor as computed by Census II-X-11.

The results of this method were (in some cases far) more accurate than those of the original ARIMA-models, as can be seen from table 1. The ex post evaluation is restricted to the seven QFs that have been estimated thus far, from 1989-IV up to 1991-II. Four measures were computed to compare the reliability of the forecasts of the three step method with those of the univariate ARIMA models for the original series. They are shown in table 1 for the employment growth rates of all five groups in the service industry considered here. They all point to the superiority of the three step method.

The **mean error** indicates systematic under- or overestimation of the regular figures in combination with a significant t-value. The mean error of the three-step method is always closer to zero than the mean error of the simple ARIMA forecasts and for three of the five series also its t-value decreases. In all cases the mean error does not differ significantly from zero at the 5%-level. The **mean absolute error** indicates the reliability of the forecasts, while the **root mean square error** is the root of the sum of the error variance and the squared mean error and thus indicates both level and variance of the errors. Of course one would prefer both statistics to be low. For all series both measures are smaller for the three step method than for the simple ARIMA models. The **inequality coefficient** compares the root mean square errors of different forecasts. If it is less than one the three-step method forecasts are more accurate than the simple ARIMA model forecasts, which is indeed the case for all series.[16)]

Table 1. Forecast evaluation of employment growth in five parts of the service industry[a)]

	forecasted four quarter growth			
	univarate ARIMA models for the original series		ARIMA-models for Henderson with added seasonal movement	
Business services				
Mean error..(t-value)........	-1.05	(1.5)	-0.13	(1.5)
Mean absolute error..........	1.32		0.20	
Root mean square error.......	1.86		0.24	
Inequality coefficient.......			0.13	
Social services				
Mean error..(t-value)........	-0.20	(0.8)	-0.09	(1.2)
Mean absolute error..........	0.49		0.17	
Root mean square error.......	0.66		0.19	
Inequality coefficient.......			0.29	
Health and veterinary services				
Mean error..(t-value)........	-0.41	(1.7)	-0.07	(0.3)
Mean absolute error..........	0.59		0.27	
Root mean square error.......	0.74		0.31	
Inequality coefficient.......			0.43	
Cultural and recreational services				
Mean error..(t-value)........	-0.41	(0.5)	0.04	(0.1)
Mean absolute error..........	1.64		0.87	
Root mean square error.......	2.01		1.03	
Inequality coefficient.......			0.51	
Other services				
Mean error..(t-value)........	-0.97	(1.7)	-0.14	(0.9)
Mean absolute error..........	1.43		0.37	
Root mean square error.......	1.68		0.42	
Inequality coefficient.......			0.25	

a) "Errors" are the differences between forecasted and actual values.

4. Conclusions

More timely basic statistics are necessary to improve the quality of the preliminary Flash results. However, the prospects for more timeliness seem rather dim. As the results in this paper show, the use of econometric techniques seems more promising. Employment growth in five parts of the service industry was studied. Starting from a simple extrapolation method, univariate ARIMA models reduced the forecasting errors considerably.

Decomposition of the series, however, gave even better results. The irregular and the seasonal component were removed from the series using Census II-X-11. The remaining trend×cycle series was further decomposed using the ARIMA-approach of Beveridge and Nelson. It appeared impossible, however, to model the cyclical component by a causal relationship. Subsequently, univariate ARIMA models were used to generate forecasts for the trend×cycle series, which were updated with X-11's predicted seasonal factors. The resulting forecasting errors were even smaller than those of the univariate ARIMA models for the original series.

The thus derived model forecasts take into account the expected trend, cyclical and seasonal movements. These forecasts then serve as "basic data" for the statistician constructing the Quarterly Flash, who should judge whether a further adjustment for incidental influences during the reference period is still needed.

Notes

1. For a detailed description of the QA's methodology, see Janssen and Algera (1988).
2. The methodology of the Quarterly Flash is described in Ouddeken and Zijlmans (1991).
3. See Reininga, Zijlmans and Janssen (1992).
4. See e.g. Osborn (1990) and Lee and Siklos (1991). Refer also to note 10.
5. In stead of multiplication one could use addition in this formula. The former is commonly used in the case of series with increasing trend (i.e. most economic time series), because it assumes a more or less time invariant share of the different components. Addition would mean a time changing share of the different components, which seems implausible here.
6. Trend fitting could also be mentioned here. Following that method the trend series is approximated by estimating

   $$Y_t = \beta + \Sigma\, a_n t^n, \text{ where } t = \text{time } (1,2,3,4 \text{ etc.}) \text{ and } n = 1,\ldots,N.$$

   We do not consider the perfectly smooth trend that results from this method very plausible.
7. See e.g. Fase and Bikker (1985), Bikker and De Haan (1988, 1990), and Van Duijn (1978) for Dutch business cycle research. The duration of the cycle does not only vary in The Netherlands, of course. See e.g. Zarnowitz (1985).
8. For a full discription of the method see e.g. Fase and Bikker (1985), Appendix I.
9. See Bikker and De Haan (1990).
10. Series can only be modeled by ARIMA models if they are stationary. This is a rather complex assumption which is usually restricted to limited variance and limited autocorrelations. If a series is not stationary it has to be differenced, in which case $\Delta x_t = x_t - x_{t-1}$ is modeled in stead of x_t. And if Δx_t is not stationary, $\Delta^2 x_t = \Delta x_t - \Delta x_{t-1}$ must be modeled, etc. Two tests are commonly used to indicate how many times a series has to be differenced in order to obtain stationarity, the Durbin-Watson test and the Dickey-Fuller test. If the levels are stationary, the series is said to be I(0), if the series has to be differenced once it is called I(1), twice I(2) etc.
11. As the resulting trend series appears to be very "irregular", we used some centred moving avarage filtering to smooth the series. So part of the advantage mentioned here is lost.
    Two drawbacks of the method have been put forward in the literature.

    a. Mills (1990, pp. 210-11) criticizes the method because the trend and the cycle are supposed to be *perfectly* correlated. This is not a common view in trend-cycle analysis. On the other hand, he admits that the proposed decomposition is indeed possible. Therefore, we gave more weight to the advantage of working with a one-sided filter than to this obviously minor drawback.

    b. Campbell and Mankiw (1987, p. 116) find that in some of the resulting series the persistence of shocks in the cycle and the trend is almost equal, while their persistence should of course be significantly higher in the trend than in the cycle. To verify whether this is also true in our case, Cochrane's V was used. It is defined as (see e.g. Campbell and Mankiw (1987)):

$V = 1 + 2 \sum [1 - j/(k+1)] p_j$, where j = period,
k = total number of periods considered, and
p = the (sample) autocorrelation.

Cochrane's V for employment in the Business Services

k	trend component	cyclical component	original series
10	7.1	5.6	7.5
20	8.6	5.4	8.5
30	8.7	4.3	10.0

As k increases, the difference between the V of the trend and that of the cycle should also increase. Moreover, the cycle's V is expected to decrease as k increases: a shock must fade out in the cycle. In our case, both assumptions are confirmed, as can be seen from the table. Apparently, the objection of Campbell and Mankiw does not apply in our case.

If Cochrane's V is calculated for the original, undecomposed, series, the result can be interpreted as: "..the variance of the change in the random walk component [trend component] divided by the variance of the total change in output.." (Campbell and Mankiw, 1987, p. 114). Here, it shows a dominant trend influence for the original series.

12 See Bikker and De Haan (1990).

13. See Pronk and Wekker (1991).

14. The DW was originally derived to trace first-order autocorrelation. The value of the DW shown here leads to the rejection of the null hypothesis of no first-order autocorrelation. Re-estimation of (*) with first differences is the most plausible action as the autocorrelation coefficient (ρ) would be close to 1 in our case: $\rho \approx ½ (2 - DW)$. (This was verified using the Cochrane-Orcutt technique: the estimated ρ is 0.95.)

Recently the DW test statistic (with a different null hypothesis and different critical values) has been playing a role in the cointegration approach. Series can only be used in econometric relationships if they are stationary or if they are cointegrated. Cointegration means that e.g. I(1) series can be used without differencing. Whether cointegration applies can be shown by testing the stationarity of the estimation residuals. The DW-value close to zero shows that this hypothesis must be rejected, so (*) must be estimated with first differences and not with levels.

15. The ARIMA models for the Henderson series are shown in the appendix.

16. The formulas used are (for the inequality coefficient see section 1.1):

$MAE = 1/n \Sigma |F - R|$

$RMSE = 1/n \sqrt{\Sigma (F - R)^2}$

$ME = 1/n \Sigma (F - R)$

17. See also note 10.

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Appendix. ARIMA modelling of Employment in the Service Industry

The estimation results for the original, undecomposed, series are shown in table A1. In all cases first differences are modeled in stead of levels as the series were shown to be I(1).[17)]

Table A1. Estimation results of ARIMA-modelling of the undecomposed employment time series

1. BUSINESS SERVICES

$$\Delta_1 X = (1 + \underset{(4.2)}{0.54}\, B4)\, A + \underset{(2.9)}{0.02} - \underset{(6.1)}{0.17}\, \Delta_1\, L25 + \underset{(5.6)}{0.16}\, \Delta_1\, L33 - \underset{(5.5)}{0.10}\, \Delta_1\, D13 - \underset{(3.4)}{0.09}\, \Delta_1\, L31 - \underset{(2.9)}{0.04}\, \Delta_1\, S40$$

R^2 (adjusted) = 0.983 estimation period 1976-I/1991-I

2. SOCIAL SERVICES

$$\Delta_1 X = (1 + \underset{(2.9)}{0.37}\, B4)\, A + \underset{(2.8)}{0.01} + \underset{(5.4)}{0.11}\, \Delta_1\, L41 + \underset{(2.9)}{0.02}\, \Delta_1\, S30$$

R^2 (adjusted) = 0.981 estimation period 1976-I/1991-I

3. HEALTH AND VETERINARY SERVICES

$$\Delta_1 X = A + \underset{(7.4)}{0.02} + \underset{(7.0)}{0.16}\, \Delta_1\, L29 - \underset{(4.0)}{0.09}\, \Delta_1\, L21 + \underset{(3.5)}{0.05}\, \Delta_1\, D8 + \underset{(2.9)}{0.03}\, \Delta_1\, S39$$

R^2 (adjusted) = 0.996 estimation period 1979-I/1991-I

4. CULTURAL AND RECREATIONAL SERVICES

$$\Delta_1 X = (1 - \underset{(4.3)}{0.54}\, B1)\, A + \underset{(4.7)}{0.01} + \underset{(6.5)}{0.03}\, \Delta_1\, S10 + \underset{(6.0)}{0.11}\, \Delta_1\, L41 - \underset{(4.4)}{0.08}\, \Delta_1\, D13 + \underset{(4.2)}{0.08}\, \Delta_1\, D19 - \underset{(3.2)}{0.06}\, \Delta_1\, L34$$

R^2 (adjusted) = 0.971 estimation period 1976-I/1991-I

5. OTHER SERVICES

$$\Delta_1 X = \frac{(1 - \overset{(3.1)}{0.46}\, B3)\,(1 + \overset{(1.8)}{0.32}\, B8)}{(1 - \underset{(2.0)}{0.34}\, B4)}\, A + \underset{(1.9)}{0.01} + \underset{(4.1)}{0.08}\, \Delta_1\, L29$$

R^2 (adjusted) = 0.980 estimation period 1979-I/1991-I

where
- X = employment (persons divided by 100,000)
- A = error term
- $\Delta_1 X = X_t - X_{t-1}$
- $B\tau$ = lag operator: $B\tau\, y = y_{t-\tau}$
- L, S and D are dummies ("intervention variables"), with
  - Lnn = level shift: 1 from period nn onward, 0 otherwise
  - Snn = seasonal dummy: 1 in period nn, nn+4, nn+8, ..., 0 otherwise
  - Dnn = dummy: 1 in period nn, 0 otherwise
  - nn = periodnumber: 1 = first quarter of estimation period

t-values are between brackets.

The estimation results of the ARIMA modelling of the trendxcycle component of the employment series, the so-called Henderson, are shown in table A2. The Durbin-Watson and Dickey-Fuller tests show all the Hendersons to be at least

I(1). In two cases the tests showed indications that the series might even be I(2). As the evidence was not conclusive, all ARIMA models were estimated for once differenced Hendersons. That the models have become more stable can be seen from the fact that now only one intervention variable was found.

Table A2. Estimation results of ARIMA-modelling of the Henderson series of the employment time series

1. BUSINESS SERVICES

$$\Delta_1 X = \frac{1}{(1 - \underset{(15.5)}{1.62}\,B1 + \underset{(9.0)}{1.39}\,B2 - \underset{(6.2)}{0.66}\,B3)}\,A + \underset{(1.6)}{0.003}$$

R^2 (adjusted) = 0.998 estimation period 1976-I/1991-I

2. SOCIAL SERVICES

$$\Delta_1 X = \frac{(1 - \overset{(2.7)}{0.45}\,B2)(1 - \overset{(6.9)}{0.76}\,B8)}{(1 - \underset{(14.4)}{1.46}\,B1 + \underset{(8.0)}{0.73}\,B2)}\,A + \underset{(3.5)}{0.002}$$

R^2 (adjusted) = 0.998 estimation period 1976-I/1991-I

3. HEALTH AND VETERINARY SERVICES

$$\Delta_1 X = \frac{(1 - \overset{(2.8)}{0.44}\,B8)}{(1 - \underset{(11.0)}{1.54}\,B1 + \underset{(5.1)}{1.03}\,B2 - \underset{(1.9)}{0.25}\,B3)}\,A + \underset{(2.8)}{0.006}$$

R^2 (adjusted) = 0.998 estimation period 1979-I/1991-I

4. CULTURAL AND RECREATIONAL SERVICES

$$\Delta_1 X = \frac{1}{(1 - \underset{(11.6)}{1.47}\,B1 + \underset{(7.0)}{1.21}\,B2 - \underset{(3.8)}{0.48}\,B3)}\,A + \underset{(1.6)}{0.002} - \underset{(3.2)}{0.01}\,L20$$

R^2 (adjusted) = 0.997 estimation period 1976-I/1991-I

5. OTHER SERVICES

$$\Delta_1 X = (1 + \underset{(13.6)}{1.44}\,B1 + \underset{(6.8)}{0.74}\,B2)\,A + \underset{(3.4)}{0.01}$$

R^2 (adjusted) = 0.998 estimation period 1979-I/1991-I

where
- X = employment (persons divided by 100,000)
- A = error term
- $\Delta_1 X = X_t - X_{t-1}$
- $B\tau$ = lag operator: $B\tau\, y = y_{t-\tau}$
- Lnn = level shift: dummy variable with value 1 from period nn onward, 0 otherwise
- nn = periodnumber: 1 = first quarter of estimation period

t-values are between brackets.

National Accounts Occasional Papers

NA/01 **Flexibility in the system of National Accounts**, Van Eck, R., C.N. Gorter and H.K. van Tuinen (1983).
This paper sets out some of the main ideas of what gradually developed into the Dutch view on the fourth revision of the SNA. In particular it focuses on the validity and even desirability of the inclusion of a number of carefully chosen alternative definitions in the "Blue Book", and the organization of a flexible system starting from a core that is easier to understand than the 1968 SNA.

NA/02 **The unobserved economy and the National Accounts in the Netherlands, a sensitivity analysis**, Broesterhuizen, G.A.A.M. (1983).
This paper studies the influence of fraud on macro-economic statistics, especially GDP. The term "fraud" is used as meaning unreporting or underreporting income (e.g. to the tax authorities). The conclusion of the analysis of growth figures is that a bias in the growth of GDP of more than 0.5% is very unlikely.

NA/03 **Secondary activities and the National Accounts: Aspects of the Dutch measurement practice and its effects on the unofficial economy**, Van Eck, R. (1985).
In the process of estimating national product and other variables in the National Accounts a number of methods is used to obtain initial estimates for each economic activity. These methods are described and for each method various possibilities for distortion are considered.

NA/04 **Comparability of input-output tables in time**, Al, P.G. and G.A.A.M. Broesterhuizen (1985).
It is argued that the comparability in time of statistics, and input-output tables in particular, can be filled in in various ways. The way in which it is filled depends on the structure and object of the statistics concerned. In this respect it is important to differentiate between coordinated input-output tables, in which groups of units (industries) are divided into rows and columns, and analytical input-output tables, in which the rows and columns refer to homogeneous activities.

NA/05 **The use of chain indices for deflating the National Accounts**, Al, P.G., B.M. Balk, S. de Boer and G.P. den Bakker (1985).
This paper is devoted to the problem of deflating National Accounts and input-output tables. This problem is approached from the theoretical as well as from the practical side. Although the theoretical argument favors the use of chained Vartia-I indices, the current practice of compilating National Accounts restricts to using chained Paasche and Laspeyres indices. Various possible objections to the use of chained indices are discussed and rejected.

NA/06 **Revision of the system of National Accounts: the case for flexibility**, Van Bochove, C.A. and H.K. van Tuinen (1985).
It is argued that the structure of the SNA should be made more flexible. This can be achieved by means of a system of a general purpose core supplemented with special modules. This core is a fully fledged, detailed system of National Accounts with a greater institutional content than the present SNA and a more elaborate description of the economy at the meso-level. The modules are more analytic and reflect special purposes and specific theoretical views.

NA/07 **Integration of input-output tables and sector accounts; a possible solution**, Van den Bos, C. (1985).
The establishment-enterprise problem is tackled by taking the institutional sectors to which the establishments belong into account during the construction of input-output tables. The extra burden on the construction of input-output tables resulting from this approach is examined for the Dutch situation. An adapted sectoring of institutional units is proposed for the construction of input-output tables.

NA/08 **A note on Dutch National Accounting data 1900-1984**, Van Bochove, C.A. (1985).
This note provides a brief survey of Dutch national accounting data for 1900-1984, concentrating on national income. It indicates where these data can be found and what the major discontinuities are. The note concludes that estimates of the level of national income may contain inaccuracies; that its growth rate is measured accurately for the period since 1948; and that the real income growth rate series for 1900-1984 may contain a systematic bias.

NA/09 **The structure of the next SNA: review of the basic options**, Van Bochove, C.A. and A.M. Bloem (1985).
There are two basic issues with respect to the structure of the next version of the UN System of National Accounts. The first is its 'size': reviewing this issue, it can be concluded that the next SNA should contain an integrated meso-economic statistical system. It is essential that the next SNA contains an institutional system without the imputations and attributions that pollute the present SNA. This can be achieved by distinguishing, in the central system of the next SNA, a core (the institutional system), a standard module for non-market production and a standard module describing attributed income and consumption of the household sector.

NA/10 **Dual sectoring in National Accounts**, Al, P.G. (1985).
Following a conceptual explanation of dual sectoring, an outline is given of a statistical system with complete dual sectoring in which the linkages are also defined and worked out. It is shown that the SNA 1968 is incomplete and obscure with respect to the links between the two sub-processes.

NA/11 **Backward and forward linkages with an application to the Dutch agro-industrial complex**, Harthoorn, R. (1985).
Some industries induce production in other industries. An elegant method is developed for calculating forward and backward linkages avoiding double counting. For 1981 these methods have been applied to determine the influence of Dutch agriculture in the Dutch economy in terms of value added and labour force.

NA/12 **Production chains**, Harthoorn, R. (1986).
This paper introduces the notion of production chains as a measure of the hierarchy of industries in the production process. Production chains are sequences of transformation of products by successive industries. It is possible to calculate forward transformations as well as backward ones.

NA/13 **The simultaneous compilation of current price and deflated input-output tables**, De Boer, S. and G.A.A.M. Broesterhuizen (1986).
A few years ago the method of compiling input-output tables underwent in the Netherlands an essential revision. The most significant improvement is that during the entire statistical process, from the processing and analysis of the basic data up to and including the phase of balancing the tables, data in current prices and deflated data are obtained simultaneously and in consistency with each other.

NA/14 **A proposal for the synoptic structure of the next SNA**, Al, P.G. and C.A. van Bochove (1986).

NA/15 **Features of the hidden economy in the Netherlands**, Van Eck, R. and B. Kazemier (1986).
This paper presents survey results on the size and structure of the hidden labour market in the Netherlands.

NA/16 **Uncovering hidden income distributions: the Dutch approach**, Van Bochove, C.A. (1987).

NA/17 **Main national accounting series 1900-1986**, Van Bochove, C.A. and T.A. Huitker (1987).
The main national accounting series for the Netherlands, 1900-1986, are provided, along with a brief explanation.

NA/18 **The Dutch economy, 1921-1939 and 1969-1985. A comparison based on revised macro-economic data for the interwar period**, Den Bakker, G.P., T.A. Huitker and C.A. van Bochove (1987).
A set of macro-economic time series for the Netherlands 1921-1939 is presented. The new series differ considerably from the data that had been published before. They are also more comprehensive, more detailed, and conceptually consistent with the modern National Accounts. The macro-economic developments that are shown by the new series are discussed. It turns out that the traditional economic-historical view of the Dutch economy has to be reversed.

NA/19 **Constant wealth national income: accounting for war damage with an application to the Netherlands, 1940-1945**, Van Bochove, C.A. and W. van Sorge (1987).

NA/20 **The micro-meso-macro linkage for business in an SNA-compatible system of economic statistics**, Van Bochove, C.A. (1987).

NA/21 **Micro-macro link for government**, Bloem, A.M. (1987).
This paper describes the way the link between the statistics on government finance and national accounts is provided for in the Dutch government finance statistics.

NA/22 **Some extensions of the static open Leontief model**, Harthoorn, R.(1987).
The results of input-output analysis are invariant for a transformation of the system of units. Such transformation can be used to derive the Leontief price model, for forecasting input-output tables and for the calculation of cumulative factor costs. Finally the series expansion of the Leontief inverse is used to describe how certain economic processes are spread out over time.

NA/23 **Compilation of household sector accounts in the Netherlands National Accounts**, Van der Laan, P. (1987).
This paper provides a concise description of the way in which household sector accounts are compiled within the Netherlands National Accounts. Special attention is paid to differences with the recommendations in the United Nations System of National Accounts (SNA).

NA/24 **On the adjustment of tables with Lagrange multipliers**, Harthoorn, R. and J. van Dalen (1987).
An efficient variant of the Lagrange method is given, which uses no more computer time and central memory then the widely used RAS method. Also some special cases are discussed: the adjustment of row sums and column sums, additional restraints, mutual connections between tables and three dimensional tables.

NA/25 **The methodology of the Dutch system of quarterly accounts**, Janssen, R.J.A. and S.B. Algera (1988).
In this paper a description is given of the Dutch system of quarterly national accounts. The backbone of the method is the compilation of a quarterly input-output table by integrating short-term economic statistics.

NA/26 **Imputations and re-routeings in the National Accounts**, Gorter, Cor N. (1988).
Starting out from a definition of 'actual' transactions an inventory of all imputations and re-routeings in the SNA is made. It is discussed which of those should be retained in the core of a flexible system of National Accounts. Conceptual and practical questions of presentation are brought up. Numerical examples are given.

NA/27 **Registration of trade in services and market valuation of imports and exports in the National Accounts**, Bos, Frits (1988).
The registration of external trade transactions in the main tables of the National Accounts should be based on invoice value; this is not only conceptually very attractive, but also suitable for data collection purposes.

NA/28 **The institutional sector classification**, Van den Bos, C. (1988).
A background paper on the conceptual side of the grouping of financing units. A limited number of criteria are formulated.

NA/29 **The concept of (transactor-)units in the National Accounts and in the basic system of economic statistics**, Bloem, Adriaan M. (1989).
Units in legal-administrative reality are often not suitable as statistical units in describing economic processes. Some transformation of legal-administrative units into economic statistical units is needed. This paper examines this transformation and furnishes definitions of economic statistical units. Proper definitions are especially important because of the forthcoming revision of the SNA.

NA/30 **Regional income concepts**, Bloem, Adriaan M. and Bas De Vet (1989).
In this paper, the conceptual and statistical problems involved in the regionalization of national accounting variables are discussed. Examples are the regionalization of Gross Domestic Product, Gross National Income, Disposable National Income and Total Income of the Population.

NA/31 **The use of tendency surveys in extrapolating National Accounts**, Ouddeken, Frank and Gerrit Zijlmans (1989).
This paper discusses the feasibility of the use of tendency survey data in the compilation of very timely Quarterly Accounts. Some preliminary estimates of relations between tendency survey data and regular Quarterly Accounts-indicators are also presented.

NA/32 **An economic core system and the socio-economic accounts module for the Netherlands**, Gorter, Cor N. and Paul van der Laan (1989).
A discussion of the core and various types of modules in an overall system of economy related statistics. Special attention is paid to the Dutch Socio-economic Accounts. Tables and figures for the Netherlands are added.

NA/33 **A systems view on concepts of income in the National Accounts**, Bos, Frits (1989).
In this paper, concepts of income are explicitly linked to the purposes of use and to actual circumstances. Main choices in defining income are presented in a general system. The National Accounts is a multi-purpose framework. It should therefore contain several concepts of income, e.g. differing with respect to the production boundary. Furthermore, concepts of national income do not necessarily constitute an aggregation of income at a micro-level.

NA/34 **How to treat borrowing and leasing in the next SNA**, Keuning, Steven J. (1990).
The use of services related to borrowing money, leasing capital goods, and renting land should not be considered as intermediate inputs into specific production processes. It is argued that the way of recording the use of financial services in the present SNA should remain largely intact.

NA/35 **A summary description of sources and methods used in compiling the final estimates of Dutch National Income 1986**, Gorter, Cor N. and others (1990).
Translation of the inventory report submitted to the GNP Management Committee of the European Communities.

NA/36 **The registration of processing in make and use tables and input-output tables**, Bloem, Adriaan M., Sake De Boer and Pieter Wind (1990, forthcoming).
The registration of processing is discussed primarily with regard to its effects on input-output-type tables and input-output quotes. Links between National Accounts and basic statistics, user demands and international guidelines are examined.

NA/37 **A proposal for a SAM which fits into the next System of National Accounts**, Keuning, Steven J. (1990).
This paper shows that all flow accounts which may become part of the next System of National Accounts can be embedded easily in a Social Accounting Matrix (SAM). In fact, for many purposes a SAM format may be preferred to the traditional T-accounts for the institutional sectors, since it allows for more flexibility in selecting relevant classifications and valuation principles.

NA/38 **Net versus gross National Income**, Bos, Frits (1990).
In practice, gross figures of Domestic Product, National Product and National Income are most often preferred to net figures. In this paper, this practice is challenged. Conceptual issues and the reliability of capital consumption estimates are discussed.

NA/39 **Concealed interest income of households in the Netherlands; 1977, 1979 and 1981**, Kazemier, Brugt (1990).
The major problem in estimating the size of hidden income is that total income, reported plus unreported, is unknown. However, this is not the case with total interest income of households in the Netherlands. This makes it possible to estimate at least the order of magnitude of this part of hidden income. In this paper it will be shown that in 1977, 1979 and 1981 almost 50% of total interest received by households was concealed.

NA/40 **Who came off worst: Structural change of Dutch value added and employment during the interwar period**, Den Bakker, Gert P. and Jan de Gijt (1990).
In this paper new data for the interwar period are presented. The distribution of value added over industries and a break-down of value added into components is given. Employment by industry is estimated as well. Moreover, structural changes during the interwar years and in the more recent past are juxtaposed.

NA/41 **The supply of hidden labour in the Netherlands: a model**, Kazemier, Brugt and Rob van Eck (1990).
This paper presents a model of the supply of hidden labour in the Netherlands. Model simulations show that the supply of hidden labour is not very sensitive to cyclical fluctuations. A tax exempt of 1500 guilders for second jobs and a higher probability of detection, however, may substantially decrease the magnitude of the hidden labour market.

NA/42 **Benefits from productivity growth and the distribution of income**, Keuning, Steven J. (1990).
This paper contains a discussion on the measurement of multifactor productivity and sketches a framework for analyzing the relation between productivity changes and changes in the average factor remuneration rate by industry. Subsequently, the effects on the average wage rate by labour category and the household primary income distribution are studied.

NA/43 **Valuation principles in supply and use tables and in the sectoral accounts**, Keuning, Steven J. (1991).
In many instances, the valuation of transactions in goods and services in the national accounts poses a problem. The main reason is that the price paid by the purchaser deviates from the price received by the producers. The paper discusses these problems and demonstrates that different valuations should be used in the supply and use tables and in the sectoral accounts.

NA/44 **The choice of index number formulae and weights in the National Accounts. A sensitivity analysis based on macro-economic data for the interwar period**, Bakker, Gert P. den (1991).
The sensitivity of growth estimates to variations in index number formulae and weighting procedures is discussed. The calculations concern the macro-economic variables for the interwar period in the Netherlands. It appears, that the use of different formulae and weights yields large differences in growth rates. Comparisons of Gross Domestic Product growth rates among countries are presently obscured by the use of different deflation methods. There exists an urgent need for standardization of deflation methods at the international level.

NA/45 **Volume measurement of government output in the Netherlands; some alternatives**, Kazemier, Brugt (1991).
This paper discusses three alternative methods for the measurement of the production volume of government. All methods yield almost similar results: the average annual increase in the last two decades of government labour productivity is about 0.7 percent per full-time worker equivalent. The implementation of either one of these methods would have led to circa 0.1 percentage points higher estimates of economic growth in the Netherlands.

NA/46 **An environmental module and the complete system of national accounts**, Boo, Abram J. De, Peter R. Bosch, Cor N. Gorter and Steven J. Keuning (1991).
A linkage between environmental data and the National Accounts is often limited to the production accounts. This paper argues that the consequences of economic actions on ecosystems and vice versa should be considered in terms of the complete System of National Accounts (SNA). One should begin with relating volume flows of environmental matter to the standard economic accounts. For this purpose, a so-called National Accounting Matrix including Environmental Accounts (NAMEA) is proposed. This is illustrated with an example.

NA/47 **Deregulation and economic statistics: Europe 1992**, Bos, Frits (1992).
The consequences of deregulation for economic statistics are discussed with a view to Europe 1992. In particular, the effects of the introduction of the Intrastat-system for statistics on international trade are investigated. It is argued that if the Statistical Offices of the EC-countries do not respond adequately, Europe 1992 will lead to a deterioration of economic statistics: they will become less reliable, less cost effective and less balanced.

NA/48 **The history of national accounting**, Bos, Frits (1992).
At present, the national accounts in most countries are compiled on the basis of concepts and classifications recommended in the 1968-UN-guidelines. In this paper, we trace the roots of these guidelines, compare the subsequent guidelines and discuss also alternative accounting systems like extended accounts and SAMs.

NA/49 **Quality assessment of macroeconomic figures: The Dutch Quarterly Flash**, Reininga, Ted, Gerrit Zijlmans and Ron Janssen (1992).
Since 1989-IV, the Dutch Central Bureau of Statistics has made preliminary estimates of quarterly macroeconomic figures at about 8 weeks after the end of the reference quarter. Since 1991-II, a preliminary or "Flash" estimate of GDP has been published. The decision to do so was based on a study comparing the Flash estimates and the regular Quarterly Accounts figures, which have a 17-week delay. This paper reports on a similar study with figures through 1991-III.

NA/50 **Quality improvement of the Dutch Quarterly Flash: A Time Series Analysis of some Service Industries**, Reininga, Ted and Gerrit Zijlmans (1992).
The Dutch Quarterly Flash (QF) is, just like the regular Quarterly Accounts (QA), a fully integrated statistic based on a quarterly updated input-output table. Not all short term statistics used to update the QA's IO-table are timely enough to be of use for the QF, so other sources have to be found or forecasts have to be made. In large parts of the service industry the latter is the only possibility. This paper reports on the use of econometric techniques (viz. series decomposition and ARIMA modelling) to improve the quality of the forecasts in five parts of the service industry.

NA/51 **A Research and Development Module supplementing the National Accounts**, Bos, Frits, Hugo Hollanders and Steven Keuning (1992).
This paper presents a modified national accounting system tailored to a description of the role of Research and Development (R&D) in the national economy. The main differences with the standard National Accounts are some changes in basic concepts (e.g. own-account production of R&D is considered as capital formation) and the introducton of additional, more detailed, classifications (e.g. new subsectors).

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