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Representativity of Short Term Statistics

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CONTENTS

Summary: Statistics Netherlands uses surveys and registrations to measure characteristics in the Dutch population. When using surveys the non-response problem will occur. Different stratums in the population may have different response behaviour. These differences in response can cause bias in estimates. As non-response and late response affect the accuracy of estimates Statistics Netherlands is researching methods to determine the representativity of surveys as a function of time.

The Short Term Statistics (korte termijn statistiek) is a survey used to monitor short-term developments in the revenue of businesses in the Netherlands. In this study we researched whether this indicator can be used as a measure of representativity and investigated how the representativity of the Short Term Statistics behaves.

The R-indicator employs estimated response probabilities of different population stratums. The more variation in those probabilities, the less representative the response and the lower the R-indicator. We use logistic regression to build a model using auxiliary variables to estimate response probabilities of the different stratums.

In this paper we start with describing the background information on the Short Term Statistics, monthly and quarterly turnovers derived from the Value Added Tax (VAT) and we explain the statistical methodology. Next we propose what auxiliary variables to use in the logistic regression. We found that we could only use the variables business type (SBI), VAT and size of business (GK). The best model was a multivariate model with variables VAT and GK. Furthermore the confidence intervals of the R-indicators suggested that the model could be used for measuring the representativity of the Short Term Statistics.

Based on the model for response we investigate various research questions. We determine how the representativity of the Short Term Statistics behaves over time. Also looking at how the mean revenue develops over time we come to a conclusion on the number of days needed for the Short Term Statistics to become reliable enough for publication. We found that 30 days was sufficient for industry, whereas retail trade never became representative enough for publication. We also found that in case of retail late respondents consisted of businesses with lower revenues.

We have investigated differences between data collection methods and the different months. We found that the month November was less representative in comparison to other months. For paper questionnaires we found that retail trade showed less representative response in comparison to electronic questionnaires. We could not find this difference in industry. Finally we discussed what population stratums need response improvement. We came to the conclusion that GK groups 1 and 2 for retail need the most improvement, whereas for industry GK group 5 could be improved.

Keywords: VAT; R-indicator;non-response; non-response Bias; missing data

1. Introduction

Statistics Netherlands is a national statistical office which gathers statistical characteristics about persons and enterprises through surveys and registers. From these surveys and registers Statistics Netherlands makes publications about many issues with regard to the Netherlands. These publications can among others circumvent changes in the economy; examples are inflation or increase in revenue for different branches. The Dutch government and businesses can use these publications to adjust their policy or business strategy. Moreover, a lot of statistics are mandatory by European legislation, as they provide important information for financial (ECB) and political decisions. Eurostat will compel the Netherlands to measure certain types of statistics. Statistics Netherlands will then be called in to gather the requested information and to ensure the reliability.

These statistics sometimes have bearing on businesses in the Netherlands. Therefore businesses are sometimes compelled to participate in surveys to ensure Statistics Netherlands is able to provide reliable and accurate statistics. However Statistics Netherlands is not the only government organisation that requires the cooperation of businesses. Often different government agencies approach businesses multiple times with similar requests for data. This redundancy is considered by businesses as an administrative burden.

Therefore government policy stipulates that administrative burden of businesses need to be reduced. To achieve this goal government organisations need to work together to reduce the redundancy. For this reason Statistics Netherlands is given access to different types of registers maintained by other government organisations like the Tax Office or the Chambers of Commerce. These registers could lead to replacement of some surveys or can be used as auxiliary information about the population. As registers cover complete populations the estimates should be much more accurate. However as other government organisations collect this data and definitions can differ between organisations registers pose new methodological problems.

Registers or surveys will always be affected with an error. In Bethlehem et al. (2006) distinctions were made between the different types of errors that can occur in surveys and or registers. These different errors eventually lead up to a total error which causes the estimate to differ from the actual population characteristic. In figure 1.1 we see the taxonomy of survey errors as provided by Bethlehem et al. (2006). The first distinction that is made in the total error is between sampling errors and non-sampling errors. Sampling errors only occur in surveys, whereas non-sampling errors may also occur in observations of the whole population.

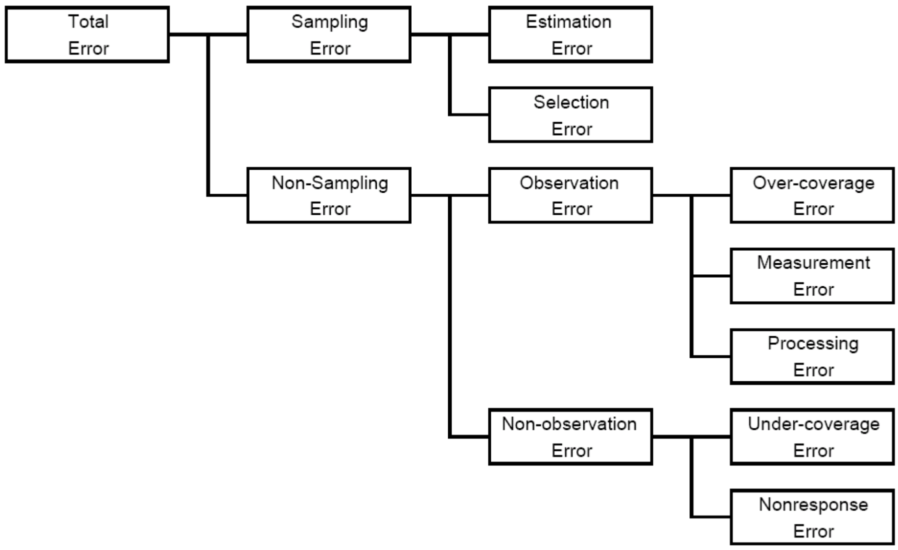
Sampling errors are errors which occur because of discrepancies between the whole population and the sample. In Bethlehem et al. (2006) sampling errors are divided into selection errors and estimation errors which denote the error that occurs through random sampling of a population. Selection errors occur when true selection probabilities are different from anticipated selection probabilities.

Non-sampling errors are errors made in the process of acquisition of survey or register answers. Bethlehem et al. (2006) divides non-sampling errors into observation errors and non-observation errors. Observation errors consist of processing errors made in data processing for example converting paper surveys to computer data, measurement errors are caused by unwillingness or incompetence to correctly answer the questions asked and over-coverage errors occur when participants are included that do not belong to the population. Non-observation errors consist of under-coverage errors which indicate that not all elements of the population can be found in the survey sampling frame. The most influential non-observation error is non-response.

Non-response can cause problems if response probabilities differ between stratums of the population. In this case the representativity of the survey is reduced and non-response bias can occur in the estimator of the target variable.

When using surveys, various methods of data collection can be chosen. Distinctions can be made between traditional paper surveys and electronic surveys. As paper surveys are more labour intensive and thereby more expensive Statistics Netherlands prefers the latter option. However as some businesses can only respond through paper surveys and others might not respond electronically, it is difficult to completely replace paper surveys.

Figure 1.1 Taxonomy of survey errors. (Bethlehem et al. 2006)



As Statistics Netherlands has access to registers from other organisations like the IRS, Statistics Netherlands is looking for methods to combine the different data. In this paper we will use the VAT data of the IRS and investigate if this information can be used in combination with the Short Term Statistics (STS). The STS is a survey which investigates the turnover of businesses. A paper by Hoekstra (2007) has researched the speed of response of the STS with regard to different modes of data collection. In Hoekstra (2007) no conclusions were drawn about the quality of the response. This paper will elaborate on this aspect.

Statistics Netherlands is constantly trying to improve estimates and determine when data is good enough for publishing. Therefore Statistics Netherlands is trying to find measures that describe the representativity of surveys. Intuitively we might assume that more response automatically would result in better estimates. However, Schouten (2004) has shown that more response does not always constitute more accurate estimates. Therefore, measures of representativity are needed to describe whether a survey is likely to give a good representation of the real population. Schouten and Cobben (2007) have described several indicators for the representativity from which one was chosen for our research. The indicator for the representativity will be referred to as the R-indicator. We will look into this R-indicator and investigate how it develops in time and how it varies between different modes of data collection for a number of subpopulations.

The goal of this paper is to investigate whether the R-indicator can be used to determine the moment a survey becomes representative for the population and thus can be used to produce reliable estimates. We will present a model for the STS with help of the statistical business register and VAT data. An overview of differences in R-indicators for various business types and methods of data collection will be given. From these we answer questions on various differences in response that might occur in the STS and differences between VAT and STS data.

For the calculation of the R-indicator we need to identify population stratums with different response behaviour. These stratums will then be used to estimate the probability of response. We use logistic regression to estimate the response probabilities. The logistic regression estimator relies on auxiliary variables to describe the response behaviour by creating different stratums. If these variables are not available or cannot describe the response behaviour, the target variable cannot be corrected for non-response bias.

In chapter 2 we will describe the R-indicator as introduced by Schouten and Cobben (2007). Furthermore we will describe in more detail the research questions and data used for the research. Chapter 3 will consist of a description of different auxiliary variables used for the logistic regression model and explain the choices that were made. We will then use this model to determine the development in time of the R-indicator and compare it against the bias. Finally in chapter 4 through 8 we will sum up the results for the different research questions.

1.1 Research questions

In this paper we will research the representativity of the response to the STS. In our analysis we used the STS of the year 2007 and VAT from 2006 and 2007. We limit ourselves to researching the enterprise groups industry and retail trade. In order to determine the representativity of the different branches within the STS we first need to answer the following questions for industry and retail trade:

- Which of the available variables may be used in the logistic regression model? (§3.1-3.3)

- How to estimate response probabilities using the available auxiliary variables? (§3.4)
- Is the R-indicator suitable for measuring bias in the response of STS? (H4)

If these questions are answered positively we continue our research with the following questions:

- Does a discrepancy exist between "early" and "late" response for industry or retail trade? (H4)
- After how many days does the STS become representative for industry and retail? (H5)
- Do the results differ for the different modes of data collection (paper / electronic (html)? (H6)
- Is there a difference in response for the different months of the year? (H7)
- What subpopulations in the STS should receive more attention in order to improve the representativity of the response? (H8)

1.2 Research strategy

Three data sources (VAT, Statistical Business Register, STS) are used to make a logistic regression model for the estimation of the response probabilities. In chapter 2 we will describe the different variables that were at our disposal and amplify the choices that were made. We will describe which variables were used in the model. Furthermore, we will make a description of the variables that could not be used and variables that could be used but were not chosen for the model. This includes the VAT data from the previous year.

We will try to use the auxiliary variables to determine the representativity of the STS. We will use logistic regression to determine the best model and retrieve estimated response probabilities. From the response probability we can then determine the R-indicator itself.

We will look at the R-indicator to assess whether the R-indicator detects a bias and see if the R-indicator behaves as we would expect. Because of the fact that the R-indicator is an estimator we will also have to determine confidence intervals to assess the reliability of the R-indicator.

After researching the best model and the reliability we focus on the possible discrepancy between early and late respondents. We look at different points in time to see the behaviour of the R-indicator.

Another aspect we research is the differences in the VAT and STS revenues. We again looked at different points in time to see when the mean of the VAT and STS showed discrepancies.

We investigate when the fluctuations of the revenue start to dissipate. In combination we looked at the chosen models for industry and retail against response representativity functions to see when the R-indicator will reach certain predefined limits. Using this information we should be able to make statements on the time needed for the estimates to become reliable enough for publication.

In section 1.1 it was explained that different methods of data collection exist, we will determine for both retail as industry if the method of data collection is of any influence on response. We will determine the R-indicators for both electronic and paper surveys and see whether differences can be seen in the representativity of both methods.

The STS may have seasonal trends with respect to the representativity. We will determine if a difference exist in response between months and how it affects the representativity for each individual month. Statistics Netherlands can use this information to try to improve the representativity in months that are less representative than others.

Statistics Netherlands is constantly trying to improve estimates. Therefore it could be helpful to know which stratums in the population turn up most strong in the R-indicators. We will describe which stratums do not need any further improvement and which stratums respond significantly less than other stratums.

2. Data and Methods

In this chapter we will describe the data and background necessary for our research. We will start by describing the data and data collection methods followed by the various mathematical methods used in our research.

2.1 DATA: Short Term Statistics, Statistical Business Register & VAT

Three surveys/registers were used to determine the representativity. In section 2.1.1 we will describe the Short Term Statistics[1] followed by the Statistical business register[2] in section 2.1.2 and VAT[3] (Value Added Tax) in section 2.1.3. We start with describing the CBS strategy of data collection.

When estimating characteristics of a population Statistics Netherlands uses a strategy (Göttgens et al., 2005) that makes distinctions in types of data sources:

- Data collected by Statistics Netherlands are called primary data
- Data derived from public or non-public registrations are called secondary data.

Preparatory, Statistics Netherlands needs to determine what the demands are of the statistical information including quality standards. The strategy states that characteristics of the population should be derived or estimated using registers first; otherwise Statistics Netherlands may use primary data for its estimations. As secondary data come from other (government) organisations and are also maintained by these organisations, it is necessary for Statistics Netherlands to determine the usability of the data. Göttgens et al. (2005) describe different aspects that need to be researched. These are:

- Timeliness
- Completeness
- Quality
- Costs of use

Statistics Netherlands publishes statistics according to deadlines often pre-described by Europe; registers need to be available before this deadline. If the timely receival of registers cannot be guaranteed Statistics Netherlands cannot use the register.

The second aspect that has to be satisfied is the completeness of the register. A (set of) register(s) is considered to be complete if the following two criteria are met.

- The information to be published can be derived/estimated fully from the variables in the secondary sources

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[1] Korte termijn Statistiek of KS

[2] Algemeen Bedrijven Register of ABR

[3] BTW van de belastingdienst

- The registers fully describe the population to be described in the statistics to be published (i.e. no under-coverage)

The quality of the data focuses on whether the data are correct. If measurement errors occur this could affect the accuracy of the estimates. Thomas (2005) describes a number of guidelines for testing the quality of registers.

Another aspect is that the use of registers could result in higher costs in comparison to primary surveys. If the costs of registers are deemed irresponsible, Statistics Netherlands will use primary surveys instead.

If these requirements are met Statistics Netherlands can use the register. However changes in the register could possibly affect the estimates of Statistics Netherlands; therefore agreements need to be made with the organizations that registers will not change without knowledge of Statistics Netherlands.

If the different aspects are not satisfied Statistics Netherlands may use primary data to estimate the characteristics of the population. Within the primary data, different methods of data collection exist:

- Electronic surveys
- Paper surveys
- Computer Assisted Telephone Interviewing (CATI)
- Computer Assisted Personal Interviewing(CAPI)

Statistics Netherlands (often) uses mixed-mode surveys to ensure the response is high as well as representative. In case of the Short Term Statistics Statistics Netherlands uses the paper and electronic modes, CATI is used for reminding and concurrent data collection (since the questionnaire only consists of a few questions, see figure 1).

2.1.1 Short Term Statistics

The Short Term Statistics (STS) is a mandatory survey. However even in this survey non-response still occurs. A known reason for non-response in the STS is that some businesses are unaware of this obligation. Businesses also tend to forget to respond or are unwilling to respond. Therefore businesses are reminded two times. Earlier research by Hoekstra (2007) has shown that reminders are effective to increase response.

In the questionnaire that businesses receive they are asked to return their turnover for the last period. An example of the STS questionnaire is shown in figure 1. For this survey the date and time the response has been received are recorded, so that we can research the development of the response over time.

Two distinct observation periods exist for which Statistics Netherlands derives/estimates characteristics of the population: monthly and quarterly statistics. In our research we only used the monthly variant of the STS. For the monthly statistics businesses can choose to either report every month or use a four weekly period (thus report 13 times a year). In this paper we will use the 2007 data.

An important aspect of the survey is the fact that different methods of data collection exist. Statistics Netherlands gives businesses the possibility to respond using four methods. Businesses can respond using a paper or electronic questionnaire. Electronic questionnaires are separated into three groups. We have html questionnaires with the log in codes sent by e-mail or via a letter. Lastly the possibility exists to respond through Electronic Data Reporter software (EDR), however still present in our data this method will be removed in the future. Therefore we removed the EDR from our data.

A lot of surveys assume inclusion probabilities to be equal for all elements within the population. In the STS survey choices were made to take different inclusion probabilities for different sizes of businesses and business types. This was done because economical developments in bigger businesses are of greater influence to the target variable (level and changes in total revenues) and therefore are of more interest. E.g. enterprises like Philips, Shell, Unilever, Albert Heijn, have an inclusion probability 1 (meaning that they are in the sample at all times), while small grocery shops have an inclusion probability less than 1. It is however important to correct all measures against these inclusion probabilities. To be able to make distinctions auxiliary information was needed. The STS uses the Statistical Business Register to determine the size of business (GK) and business type for each business.

Figure 2.1 Questionnaire STS

Centraal Bureau voor de Statistiek
Divisie
Antwoordnummer ,
Telefoon Fax
E-mail

Terugzenden voor:
26-1-2006

VL1334
Maandenquête Industrie

Betreft periode:
TEST 2006

Uw CBS-correspondentienummer:
0000 1003

Referentienummer:
B1234 5603 / 1026 2628

00000151100
101326 992006 BES Z000

Gaarne terugzenden voor de hierboven vermelde datum in bijgevoegde portvrije retourenvelop.
Wilt u controleren of BOVENSTAANDE retourcode in het venster zichtbaar is?

NB: alle bedragen s.v.p. afronden op 1000-tallen. Dus € 23.669,75 als volgt noteren: 24

A Omzet

Industriële omzet (excl. BTW)

Waarde *1)* zelfvervaardigde producten *2)* en industriële diensten, gefactureerd aan klanten in: **binnenland** / **buitenland**

Overige omzet (excl. BTW)

Waarde *1)* van niet-industriële activiteiten *3)*, gefactureerd aan klanten in: **binnenland** / **buitenland**

totale omzet

1) Inclusief productgebonden belastingen (bijv. accijnzen e.d.) en **na aftrek** *van kortingen, bonussen, retouremballage en -zendingen. WEL meetellen: kosten vervoer, verpakkingen, emballage en deelfacturen op onderhanden werk.*

2) Daaronder ook verstaan producten die in loondienst door derden zijn vervaardigd alsmede producten die uitsluitend geassembleerd worden uit ingekochte onderdelen.

3) Denk aan activiteiten zoals het verkopen van producten **zonder** *verdere (industriële) bewerking door uw bedrijf (=handel), het verhuren van goederen, (ver-)bouwwerkzaamheden en het aan derden uitlenen van personeel.*

2.1.2 *Statistical Business Register*

The Statistical Business Register (SBR) is an up-to-date list of all known businesses within the Netherlands It is used as a sampling frame for many business surveys, like the STS. This register contains data on location and contact information (such as telephone number or adress). As described in 2.1.1, distinctions are made on importance of participation in the STS. Less important businesses are sampled with a smaller probability than more important businesses. The auxiliary information that is used to make distinctions in inclusion probabilities is part of the Statistical Business Register. With help of the auxiliary information we can determine the representativity of the response and possibly correct for non-response.

An example of the file is given in appendix A. In this file we see the following variables,

- 'BE_id' is the identity of businesses
- 'Opgave_id' is an ID for the received response
- 'GK' is the size of a business in classes see Appendix B.
- 'SBI' is the statistical classification of economic activity see Appendix C
- 'Waarneemmedium' is the method used for data collection: S paper, HS electronic log in codes via letter, HE electronic log in codes via e-mail and EM is via Electronic Data Reporter software.
- 'Waarde' is the STS Revenue for every business in the survey.

In appendix B the GK table is given, here we can see the number of employees belonging to each class. Another variable is SBI, see appendix C. This variable categorizes businesses according to their main economic activity. These distinctions are mostly made by Eurostat. An example of the different SBI type businesses would be catering industry or fishing industry.

Without the sampling frame (in this case the Statistical Business Register) it would not be possible to make accurate estimates on the changes in the total Revenues for businesses. In that case Statistics Netherlands would not have knowledge on the (sub)population(s) of businesses. A few of the goals of the register are to serve as a survey sample frame and to reduce the non-response burden. This is achieved by having information on among others the population size, location of the businesses, sizes of business and economic activity. The Statistical Business Register has been created with help of multiple sources. These sources are among others the Chamber of Commerce, the Dutch postal organisation, feedback information from statistical surveys and the registers of the taxation administration. For a more detailed description of the statistical business register see Ritzen (2007)

2.1.3 *VAT*

The Dutch Tax Authorities (IRS) deliver data on VAT to Statistics Netherlands. Although it would be preferred to use the VAT to replace the STS, the VAT revenue cannot yet be used to estimate the total monthly revenues in the Netherlands. The main reason is that business units as described by Statistics Netherlands (in the

SBR) do not match fiscal units as defined by the Tax Office. Other reasons are 1) timeliness and 2) discrepancies caused by differences in definitions.

However it is still possible to use the VAT of the previous year(s) as an auxiliary variable. When using VAT of the previous year(s) as an auxiliary variable the complications related to timeliness and differences in definitions reduce. In our research we used the VAT revenue from the year 2006 and 2007.

2.2 R-indicator

In this section we discuss the methodology that we use in the analyses of the research questions. Response probabilities play an important role throughout our research. Therefore, we start with modelling individual response probabilities. These probabilities then form the basis for so-called R-indicators. R-indicators measure the representativeness of response, i.e. the extent to which response and target population have similar distributions for auxiliary characteristics. Finally, we discuss measures with which we can assess the usefulness of R-indicators in evaluating the representativeness of response for business turn-over.

2.2.1 Models for individual STS response probabilities

Logistic regression is often used in statistics to make predictions about a binary target variable. To predict the occurrence of an event the logistic regression model uses one or more auxiliary variables; in our case response probabilities. The auxiliary variables used in the logistic regression model can either be categorical or continuous. The logits, the inverse of the logistic function, of the response probabilities are modelled as a linear function of the auxiliary variables.

$$\log(\frac{\rho_i}{1-\rho_i}) = \beta_0 + \beta_1 x_{1,i} + \beta_2 x_{2,i} + \ldots + \beta_k x_{k,i} \qquad (1)$$

The probability of response for business *i* is then defined as

$$\rho_i = \frac{1}{1+e^{-(\beta_0+\beta_1 x_{1,i}+\beta_2 x_{2,i}+\ldots+\beta_k x_{k,i})}} \qquad (2)$$

Where β_0 is the intercept and $\beta_1, \beta_{2,\ldots,} \beta_k$ are the regression coefficients of auxiliary variables $x_1, x_{2,\ldots,} x_k$. The intercept is the value of $\log(\rho_i / 1-\rho_i)$ when all auxiliary variables are set to 0. In case of categorical auxiliary variables a group is chosen as the reference category. The regression coefficients are the contribution factors of the various auxiliary variables. A positive coefficient for a particular auxiliary variable depicts an increase in comparison to the reference group whereas negative coefficients depict a decrease in the response probability. Using the response probabilities estimated with help of the logistic regression, we can estimate the R-indicator as described by Schouten and Cobben (2007).

2.2.2 Measures for representativeness of STS response; R-indicators

As surveys have the problem of non-response, measures of representativity can help decide if and when surveys have become sufficiently representative for publication. Schouten and Cobben (2007) have described so-called R-indicators which could be used for this purpose. In this paper we will use an R-indicator to determine the representativity of STS response, which is based on estimated response probabilities of businesses. The idea behind the R-indicator is that an increase in the variation of response probabilities has a negative effect on the quality of response.

We let $i=1,2,3,\ldots,N$ be the labels of the population units; in our case of businesses. The 0-1 indicator that an element from the population is drawn in the survey is denoted by s_i. π_i will be the inclusion probability of the unit, i.e. the design probability that the element is drawn into the survey. In most business surveys inclusion probabilities are taken proportional to the number of employees. This is also true for the STS.

Let r_i^t be the 0-1 indicator that an element has responded in the STS at time t. We will denote the response probability for unit i at time t by ρ_i^t. We estimate this probability following a logistic regression model as described in the previous section. $\hat{\rho}_i^t$ denotes this estimate.

In our study we want to determine the representativity at different points in time. The R-indicator presented by Schouten and Cobben (2007) is given (modified to include time t) below:

$$\hat{R}^t(\hat{\rho}^t) = 1 - 2\sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\frac{s_i}{\pi_i}(\hat{\rho}_i^t - \hat{\bar{\rho}}^t)^2}\ , \tag{3}$$

where $\hat{\bar{\rho}}^t = \frac{1}{N}\sum_{i=1}^{N}\frac{s_i}{\pi_i}\hat{\rho}_i^t$ is the weighted average of the estimated response probabilities.

The R-indicator in (3) is a transformation of the estimated standard deviation of estimated response probabilities to the [0,1] interval. The larger the variation of the probabilities, the less representative the response, and the lower the R-indicator.

In order to be able to interpret the values of R-indicators, it is important that we can attach a meaning to these values in terms of non-response bias. In other words we would like to link the R-indicator directly to bias of standard estimators[4].

The Horvitz-Thompson estimator is the most simple estimator for the population average of a survey item y that accounts for the sampling design. It has the following form

[4] In this case total revenues of KS and VAT for industry and retail.

$$\hat{\bar{y}}_{HT}^t = \frac{1}{N}\frac{n}{r^t}\sum_{i=1}^{N}\frac{r_i^t}{\pi_i}y_i \ , \tag{4}$$

where r^t is the size of the response at time *t,* and *n* is the sample size. Bethlehem (1988) has shown that its bias is approximated by

$$B(\hat{\bar{y}}_{HT}^t) = \frac{C(y,\rho^t)}{\bar{\rho}^t}, \tag{5}$$

where $C(y,\rho^t) = \frac{1}{N}\sum_{i=1}^{N}(y_i - \bar{y})(\rho_i^t - \bar{\rho}^t)$ is the population covariance between response probabilities and survey items and $\bar{\rho}^t$ is the population mean of the response probabilities at time t.

The bias in (5) can be bounded in absolute sense by

$$\left|B(\hat{\bar{y}}_{HT}^t)\right| \leq \frac{S(\rho^t)S(y)}{\bar{\rho}^t} = \frac{(1-R(\rho^t))S(y)}{2\bar{\rho}^t}. \tag{6}$$

where $S^2(\rho^t)$ depicts the sample variance of the response probabilities and $S^2(y)$ the sample variance of the target variable. As the survey consists of various survey items *y*, we standardize (6) by $S(y)$

$$\frac{\left|B(\hat{\bar{y}}_{HT}^t)\right|}{S(y)} \leq \frac{S(\rho^t)}{\bar{\rho}^t} = \frac{1-R(\rho^t)}{2\bar{\rho}^t}. \tag{7}$$

The bound in (7) holds for any survey item, and as a consequence is not very strict. Furthermore, the bound is unknown as we do not know the population standard deviations of the response probabilities. We can, however, replace response probabilities by estimated response probabilities in order to get a worst case scenario bias

$$B_S^t = \frac{1-\hat{R}(\hat{\rho}^t)}{2\hat{\bar{\rho}}^t}, \tag{8}$$

which we will refer to as the maximal absolute bias.

We can use (8) to define response-representativity curves. Let γ be some pre-scribed level of maximal bias, then the response-representativity curve for γ follows from

$$\gamma \geq \frac{1-R(\hat{\rho}^t)}{2\hat{\bar{\rho}}^t}, \text{ and hence } R(\hat{\rho}^t) \geq 1-\gamma 2\hat{\bar{\rho}}^t. \tag{9}$$

In the analyses in the subsequent sections we will use various levels for γ .

As the R-indicator is based on a sample and on estimated response probabilities, it is a random variable itself. Consequently, it has a standard error and we need to use confidence intervals rather than point estimates alone.

We estimate standard errors using a naïve non-parametric bootstrap and construct confidence intervals by assuming a normal distribution.

In order to measure the possible measurement error of the R-indicator we will use the bootstrap method. The bootstrap mean of the R-indicator we denote with

$$\hat{\bar{R}}^{*t} = \frac{\sum_{b=1}^{B^*} \hat{R}^{*t}(\hat{\rho}_b^t)}{B^*} \qquad (10)$$

Where $\hat{R}^{*t}$ are the bootstrap R-indicators, $\hat{\rho}_b^t$ the estimated response probabilities for the bootstrap sample and B^* the number of bootstrap runs. We draw a simple random sample with replacement of the Short Term Statistics dataset and calculate the R-indicator for each sample. We found that using a 100 bootstrap runs was sufficient in our case. The standard deviation of the bootstrap R-indicators is denoted by

$$\hat{S}^{*t}(\hat{\bar{R}}^{*t}) = \sqrt{\mathrm{var}(\hat{\bar{R}}^{*t})} = \sqrt{\frac{1}{B^*-1}\sum_{b=1}^{B^*}(\hat{R}^{*t}(\hat{\rho}_b^t) - \hat{\bar{R}}^{*t})^2} \qquad (11)$$

Using the bootstrap mean and standard deviation we can now create a confidence interval with help of

$$\hat{\bar{R}}^{*t} \pm \xi_{1-\alpha/2} * S\hat{E}^{*t}(\hat{\bar{R}}^{*t}) \qquad (12)$$

where α is the significance level chosen. We chose α to be equal to 0.05 and thus $\xi_{1-\alpha/2}$ is equal to 1.96

2.2.3 Measures for assessing usefulness of R-indicators

In this section we will use the notation y_i^{KS} and y_i^{VAT} to denote the STS and VAT revenues of business *i*. In chapter 4 we want to investigate whether the R-indicator can be used to detect bias in the STS. For this purpose we use the following index to monitor the deviation in the mean turnover of respondents over time.

$$I_t^{KS} = \frac{\frac{1}{R_t}\sum_{i=1}^{N} r_i^t \frac{y_i^{KS}}{\pi_i}}{\frac{1}{R}\sum_{i=1}^{N} r_i \frac{y_i^{KS}}{\pi_i}} \qquad (13)$$

where $R_t = \sum_{i=1}^{N} r_i^t \frac{1}{\pi_i}$, and $R = \sum_{i=1}^{N} r_i \frac{1}{\pi_i}$ are estimators for the population size of responding business units at time t and at the end of the fieldwork period Index, (13) represents the mean turnover of responding businesses at time t, standardized by the final mean reported turnover. Ideally (13) should be close to 1. We would like to define a similar index for VAT reported revenue. However, a problem with the STS is that not all businesses within the STS have linked from VAT revenues. Therefore it is not possible to compare the VAT revenue and the STS revenue for all responding businesses.

A problem with the STS is the fact that not all businesses within the STS have VAT revenues. Therefore it is not possible to compare the VAT revenue and the STS revenue with all responding businesses. We can, however, remove the businesses that did not have linked VAT revenues and compare the remaining businesses. We use the 0-1 indicator

$$k_i = \begin{cases} 0 & No\ VAT\ \ present \\ 1 & VAT\ \ present \end{cases}$$

For the VAT we calculated the mean of the response which had a VAT revenue at time t and divided it by the total mean response that had a VAT revenue. The index for the VAT revenue then becomes

$$I_t^{VAT} = \frac{\frac{1}{\widetilde{R}_t}\sum_{i=1}^{N} r_i^t k_i \frac{y_i^{VAT}}{\pi_i}}{\frac{1}{\widetilde{R}}\sum_{i=1}^{N} r_i k_i \frac{y_i^{VAT}}{\pi_i}}, \tag{14}$$

where $\widetilde{R}_t = \sum_{i=1}^{N} r_i^t k_i \frac{1}{\pi_i}$ and $\widetilde{R} = \sum_{i=1}^{N} r_i k_i \frac{1}{\pi_i}$ are estimators for the population size of responding business units at time t and at the end of the fieldwork period, respectively, for which we can find a unique VAT record. Again ideally (14) should be close to 1. For the reduced population of businesses with VAT we also compute the index for STS reported revenue. (14) should ideally resemble (15) and be close to 1.

$$\widetilde{I}_t^{KS} = \frac{\frac{1}{\widetilde{R}_t}\sum_{i=1}^{N} r_i^t k_i \frac{y_i^{KS}}{\pi_i}}{\frac{1}{\widetilde{R}}\sum_{i=1}^{N} r_i k_i \frac{y_i^{KS}}{\pi_i}} \tag{15}$$

The indexes (13) to (15) are standardized with respect to the response mean. Clearly, we are interested in the mean of respondents and non-respondents. For VAT we have reported revenue also for non-respondents. Hence, we define the following indicator for VAT. This index does not have to converge to 1, but should ideally be close to 1.

$$\widetilde{I}_t^{VAT} = \frac{\frac{1}{\widetilde{R}_t}\sum_{i=1}^{N} r_i^t k_i \frac{y_i^{VAT}}{\pi_i}}{\frac{1}{\widetilde{N}}\sum_{i=1}^{N} s_i k_i \frac{y_i^{VAT}}{\pi_i}} \tag{16}$$

where $\widetilde{N} = \sum_{i=1}^{N} s_i k_i \frac{1}{\pi_i}$ is an estimator for the population size of business units for which we can find a unique VAT record.

Apart from cumulative indexes we compare R-indicators to moving averages of reported revenue with windows of 5 or 10 days. I_t^{int} is either I_t^{KS} , I_t^{VAT} or $\widetilde{I}_t^{KS}$ with r_i^t replaced by $(r_i^t - r_i^{t-k})$ where k is equal to the chosen window.

3. Variable selection

In this chapter we will describe the different auxiliary variables at our disposal and the choices we made in the model selection. A logistic regression model uses auxiliary variables to predict the response behaviour. Combinations of auxiliary variables often lead to better estimates in comparison to single auxiliary variables. However combinations of auxiliary variables also lead to small(er) sub stratums and this could lead to unreliable estimates of the R-indicators. Therefore we have chosen a minimum number of 50 participants that had to be in each substratum. If this minimum number was not reached we collapsed the sub stratums. Bootstrapping our data can also affect the sizes of sub stratums, but with a minimum of 50 participants this potential problem should be avoided. Furthermore, the strata in the logistic regression model need to be constant over the different periods in time, because changes in models could have an affect on the results.

3.1 Variable selection

As we want to compare models, we first will outline the criteria that can be used to determine the best model. These are listed below.

- Goodness of fit
- Minimum R-indicator
- Accuracy of the R-indicator
- How complex is it to make the variable?
- How long does it take to make the necessary calculations? (If possible)

First, we can use the chi-squared statistic from the analysis of deviance to test whether adding additional variables is significantly improving our model. However as we have a large dataset this measure is very likely to be significant even with multiple variables.

The most important aspects are the actual value of the R-indicator and the accuracy of the R-indicator. The lower we can get the R-indicator the more accurate our estimate of the maximal bias can be. This will also help determine more accurately when a survey becomes representative enough for publication. However the R-indicator is an estimator and thus can be biased itself. Therefore we will have to determine how accurate the R-indicator is, in other words we will have to determine confidence intervals for the model. If the confidence intervals are not too big we can make predictions of the maximal bias using these indicators.

As more variables are added to a model more sub stratums are created, thereby increasing the necessity of collapsing stratums. The variable complexity (time and effort needed to process a variable) is one of the additional criteria. Finally the time needed to perform the calculation if even possible is taken into account.

3.2 The available auxiliary variables

The first auxiliary variable that we have at our disposal is the mode of data collection. As described in section 2.1 Statistics Netherlands offers businesses two methods of data reporting. The businesses can either respond via a paper survey, or via an electronic survey. Electronic surveys are offered in two options the option to receive the log in codes via e-mail and the option to receive them via a letter. Thus in the end we look at three separate methods. As discussed in section 2.1 there was also the option of using EDR, however we removed all data related to EDR as this mode of data collection will no longer be available in future surveys.

The second auxiliary variable at our disposal is the size of businesses (GK) based on the number of employees. The sizes range from 1 through 9. The number 1 represents the smallest businesses when looking at the number of employees and 9 the biggest businesses. A more detailed description of the variable can be found in appendix B.

A third auxiliary variable is the Standard Business Index (SBI). This variable makes distinctions between the different business types and basically consists of 4 or 5 digits. The first 2 digits describe the type of business, for example retail or textile industry. Every additional digit makes more distinctions on the type of business. For a more detailed description of SBI codes we refer to appendix C.

The fourth auxiliary variable is the revenue for businesses acquired from the VAT from the previous year. We made disjoint VAT groups of equal size and assigned one category for missing VAT information. Equal sized groups were not very difficult to make, and when combining variables this would also decrease the possibility of having to collapse strata. More details on the VAT classification values can be found in appendix D.

The final variable that can be used is the period of the STS. As we look over the entire year we can take the month in which the business participated in the STS into account.

As the STS is a survey with a great number of participants we chose to separate the STS into different types of businesses. We looked at the industry and retail as these are the two biggest SBI Sections and of most interest. We furthermore chose to ignore the 4 week period respondents as this group was only about 7% of the total survey. The omission of the 4 week-respondents had only a small effect on the total response.

Logistic regression models are usually fitted by some algorithm that selects variables following some pre-selected significance level. This is done by determining if the difference is due to chance given a certain confidence level or not. If the confidence level is not met, the stratums are not separated. In our case we prescribe variables regardless of significance. This second method is likely to be less accurate than the first approach and more labour intensive. However in our research we need to calculate the changes of the R-indicator in time. Therefore we will have to run a logistic regression for every point in time. If the model changes over time we cannot compare the R-indicators. When models change we would not know whether the change in the R-indicators is due to the fact that the models changed over time or that the representativity increased or decreased. We will specify the model from which the algorithm will perform the logistic regression.

3.3 A pre-selection of variables.

The STS is mostly used to make either monthly or quarterly predictions on changes in the target variable. The variable month therefore is not a variable suitable for the logistic regression model and will not be used for this purpose.

The next variable that should not be used for the logistic regression model is the mode of data collection. The mode of data collection is only to some extent chosen by Statistics Netherlands. Businesses can choose between the different methods of response Statistics Netherlands have made available. For this reason it is possible that the variable is correlated with other variables. It is likely that certain business types and sizes of business could tend more to either electronic or paper surveys. Another reason for not using the mode of data collection for the logistic regression model is due to the fact that businesses can choose for themselves which mode of data collection to use. This could lead to changing models between different months and years. Statistics Netherlands wants to compare results from different months and make conclusions on possible changes in the revenues. Therefore it is best that models differ as little as possible.

The remaining variables VAT, SBI and GK can all three be used. We divided the VAT into 3, 5, 9, 17 and 33 groups to compare results. We came to the conclusion that dividing the VAT into more than 9 groups did not yield significantly lower R-indicators. There even was hardly any discrepancy between VAT divided in 5 groups and VAT divided in 9 Groups at some points in time. The tables and plots of the R-indicators of all single variables can be seen in appendix E and F. Here, we make a small selection of models.

With respect to SBI we made distinctions between the industry and retail trade. For industry we had to prune the SBI back to 2 digits. A secondary option was to use Sub Sections. There was a small difference between SBI with only the first 2 digits and the Sub Sections. However since SBI by Sub Sections had fewer groups we only used SBI by Sub Sections in models with multiple variables. See appendix C for more details.

For retail we did not have to prune the SBI, we could use it for our logistic regression without making any alterations. However for models with multiple variables it was better to prune the SBI back to 4 and 3 digits.

3.4 Fitting models for response

3.4.1 Results of single variable models

As a first step we calculated different R-indicators for models with only one variable. For industry these can be found in table 3.1 and for retail trade in Table 3.2. From these tables we can see the changes of the different variables over time. We chose only to include days 15, 30, 45, 60 and the final total. We hope to find R-indicators close to 1 as this means that the response is more or less randomly distributed among the different stratums of the auxiliary variables.

Table 3.1 Every column depicts a different point in time for the industry, percentage response is the response received at that point, R-ind is the R-indicator of the model specified in the first column. For every R-indicator in this Table the bootstrap mean, minimum and maximum were calculated i.e. 95% confidence interval.

Industry		**15d**	**30d**	**45d**	**60d**	**tot**
percentage respons		0,49	0,79	0,86	0,88	0,92
GK	**R-ind**	0,926	0,932	0,940	0,942	0,942
	Boot mean	0,926	0,933	0,940	0,938	0,941
	Boot min	0,917	0,927	0,935	0,942	0,939
	Boot max	0,934	0,938	0,945	0,946	0,944
SBI sub sections	**R-ind**	0,909	0,943	0,969	0,974	0,978
	Boot mean	0,908	0,942	0,967	0,968	0,977
	Boot min	0,899	0,936	0,962	0,972	0,973
	Boot max	0,916	0,948	0,972	0,976	0,980
VAT 9 groups	**R-ind**	0,935	0,945	0,952	0,953	0,953
	Boot mean	0,934	0,944	0,951	0,948	0,952
	Boot min	0,927	0,938	0,946	0,952	0,948
	Boot max	0,942	0,950	0,957	0,957	0,956

Table 3.2 Retail trade R-indicators with bootstrap confidence intervals. (Same format as Table 3.1)

Retail		**15d**	**30d**	**45d**	**60d**	**tot**
respons percentage		0,50	0,78	0,86	0,88	0,92
GK	**R-ind**	0,940	0,817	0,794	0,800	0,773
	Boot mean	0,937	0,815	0,793	0,800	0,772
	Boot Min	0,921	0,794	0,775	0,784	0,759
	Boot Max	0,953	0,837	0,811	0,817	0,785
VAT 9 groups	**R-ind**	0,724	0,753	0,756	0,769	0,790
	Boot mean	0,723	0,751	0,756	0,767	0,790
	Boot Min	0,699	0,733	0,740	0,752	0,778
	Boot Max	0,747	0,769	0,772	0,782	0,802
SBI no separation	**R-ind**	0,685	0,726	0,764	0,779	0,811
	Boot mean	0,665	0,711	0,751	0,768	0,802
	Boot Min	0,640	0,685	0,735	0,754	0,791
	Boot Max	0,689	0,738	0,768	0,782	0,814

From the models in table 3.1 we can see that the R-indicators tend to increase over time to end up between 0.94 and 0.98, whereas the models of table 3.2 end up between 0.77 and 0.82. The representativity seems to be significantly lower for retail trade in comparison to industry. For industry we see a moderate rise of the representativity between 15 days and the total response, where as for retail trade we see that the representativity of the GK declines significantly over time.

In both retail and industry the GK is the biggest contributor to a possible bias, followed closely by the VAT data.

3.4.2 Best model

In tables 3.1 and 3.2 we give R-indicators for models with one auxiliary variable at various points in time. In this section we extend single variable models to multivariate models. Ideally we would like to use GK, SBI and VAT together. However, as we explained we need to account for cell sizes and variable complexity.

R-indicators can be seen in table 3.3 and table 3.4. For more detailed tables we refer to Appendix E. From table 3.3 we can see that for the industry the different two variable models (1-3) do not differ much after 30 days. The three variable model (4) results in the lowest R-indicator.

The model with GK and the VAT data (1) was relatively easy to construct although some strata needed collapsing. The other models were more troublesome, especially the three variable model (4). Another aspect to consider is the fact that Statistics Netherlands wants to use the same models for longer periods of time. In order to be able to compare results, the underlying models need to be constant. If difficult models with a lot of stratums are chosen, the risk of having to change the model due to empty or small stratums increases. The computational time of all models was within reasonable bounds. The computational time lies within a couple of hours for a single computation.

Table 3.3 R-indicator multiple variable models for industry

Model	15d	30d	45d	60d	tot
1. GK x VAT 9	0,909	0,919	0,930	0,933	0,935
2. GK x SBI sub Sections	0,871	0,903	0,926	0,933	0,937
3. VAT x SBI sub Sections	0,873	0,908	0,932	0,936	0,940
4. GK x VAT 9 x SBI sub Sections	0,841	0,877	0,904	0,912	0,917

Table 3.4 R-indicator multiple variable models for retail

model	15d	30d	45d	60d	tot
1. GK x VAT 9 groups	0,632	0,610	0,616	0,640	0,661
2. GK x SBI first 3 digits	0,821	0,722	0,716	0,721	0,731
3. GK x SBI first 4 digits	0,670	0,674	0,689	0,703	0,708
4. VAT 9 + SBI first 3 Digits	0,708	0,746	0,752	0,763	0,787
5. GK x VAT 9 x SBI 3 Digits	0,570	0,572	0,588	0,617	0,642

The Goodness of fit is a statistic that is often used to determine whether adding variables results in significant improvements of the model. However as we have a large dataset small differences are more likely to be significant. As we used the chi square statistic we found that using a model with all three variables always resulted in significant differences with smaller models.

We conclude that the best model for industry is model 1 with GK and VAT data. Even though the model with all variables (4) results in lower R-indicators and is significant according to the Goodness of fit we have to consider the practical use. The model GK x VAT 9 is easier to construct and has stable cell sizes. The STS is also calculated every month. As we used a dataset of the entire year we have to consider that a lot of stratums will need collapsing when we want to use the full variable model (4) on a monthly basis. We used the bootstrap method to check whether the R-indicator of model 1 has large confidence intervals. The resulting intervals are in table 3.5.

Table 3.5 R-indicator of the model GK x VAT 9 for industry with bootstrap means and 95% confidence intervals.

model		**15d**	**30d**	**45d**	**60d**	**tot**
GK x VAT9	**Rind**	0,909	0,919	0,930	0,933	0,935
	Boot mean	0,907	0,917	0,929	0,932	0,935
	Boot Min	0,899	0,911	0,924	0,928	0,931
	Boot Max	0,914	0,922	0,934	0,937	0,938

Table 3.6 R-indicator of the model GK x VAT 9 for retail with bootstrap means and 95% confidence intervals.

model		**15d**	**30d**	**45d**	**60d**	**tot**
GK x VAT 9 groups	**Rind**	0,631	0,610	0,616	0,640	0,661
	Boot mean	0,626	0,608	0,613	0,637	0,660
	Boot Min	0,602	0,581	0,592	0,618	0,642
	Boot Max	0,650	0,635	0,634	0,656	0,678

For retail we follow the same line of reasoning as for industry. We can see that the lowest R-indicator comes from the model with all three variables (5). The Goodness of fit also concludes that this model is significantly different from the similar models. However taking into consideration that the models need to be computed every month and that the model must remain constant for different monthly statistics we can only come to the conclusion that the model GK x VAT is again the best model. Model 1 results in significantly lower R-indicators in comparison to the models 2, 3 and 4 and model 1 is relatively easy to construct.

For retail trade the R-indicators show that the representativity is very low. In table 3.6 we see the bootstrap confidence intervals of the R-indicator for retail.

In figure 3.1 we plot the R-indicators of the model GK x VAT 9(1) with the response representativity functions of the industry[5]. The corresponding bias is shown next to the figure of the R-indicator. In figure 3.2 we do the same for retail.

Figure 3.1 *Industry: The left figure represents the R-indicator of the Model VAT 9 groups x GK against days. The three decreasing lines are the representativity functions where γ= 0.01, 0.05 and 0.1. The top line represents the stictest boundary of γ= 0.01 and the bottom line the loosest boundary of γ=0.1. The figure on the right represents the absolute maximal bias* B_S^t *for industry.*

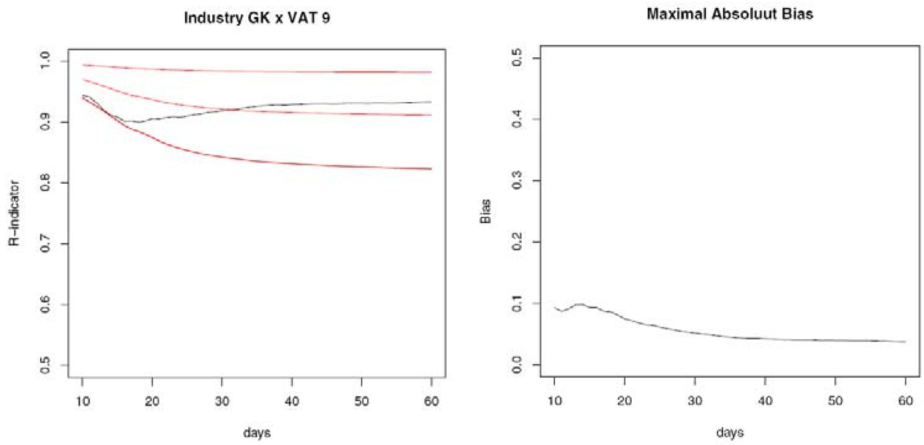
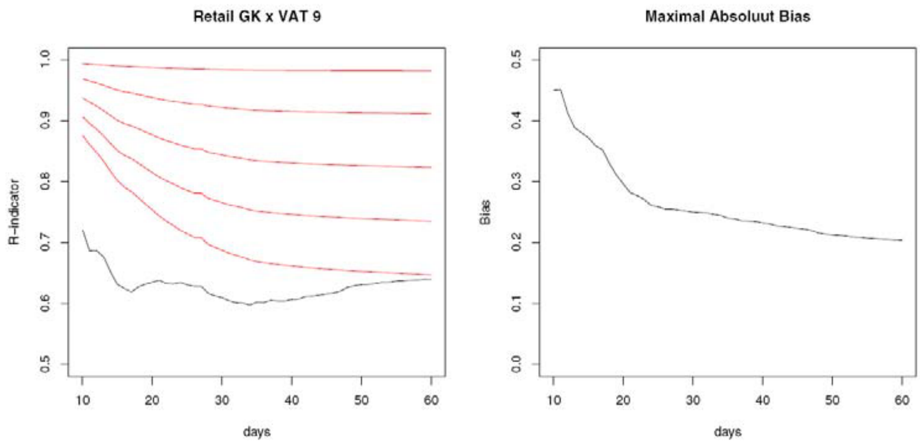


Figure 3.2 *Retail: The left figure represents the R-indicator of the Model VAT 9 groups x GK against days. The five decreasing lines are the representativity functions where γ= 0.01, 0.05, 0.1, 0.15 and 0.2. The top line represents the stictest boundary of γ= 0.01 and the bottom line the loosest boundary of γ=0.2. The figure on the right represents the absolute maximal bias* B_S^t *for retail.*



[5] For the figures we calculate the R-indicator for each day, in contradiction to tables.

From figure 3.1 we can see that the bias level for industry does not exceed the level 0.1 in the time span 10 to 60 days, whereas for retail the bias never reached the level 0.2.

4. Is the R-indicator suitable for the STS?

The R-indicator is suitable as a tool for measuring representativeness of the STS response if

- Its path in time follows expert expectations
- Confidence intervals are relatively small for the R-indicators
- Its pattern follows the bias pattern

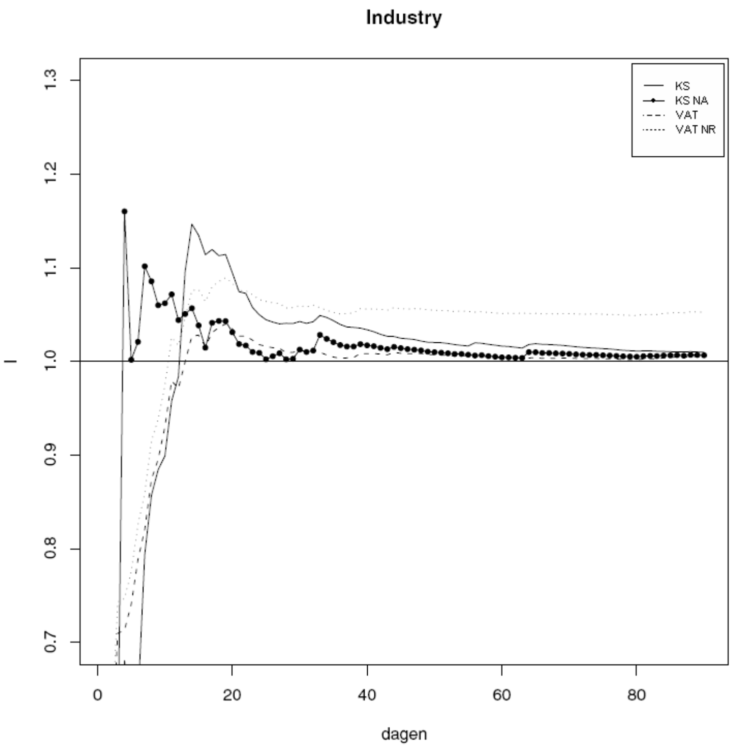
Beforehand it was anticipated that industry would show stable, relatively smooth R-indicators, while for retail the R-indicators would be more volatile. Furthermore we expect an increase in time for both industry and retail.

With help of the R-indicator discrepancies in response between stratums can be detected. From tables 3.1 and 3.2 we can see that the STS behave differently for retail and industry. When looking at the data of retail we can see that GK stratums 1 and 2 had a much lower response in comparison to other stratums from GK. This will be discussed in chapter 8. In this case the R-indicator gives a low value for the representativity. When we look at the industry we see a different picture, the response of different stratums is more similar. The R-indicators for industry and retail behave as expected.

We expected to see a moderate increase in the R-indicator over time for the different models to eventually end up close to 1. We can see in table 3.6 that for retail this is not the case. The R-indicator gives a lower estimate than expected. However as stated above we have seen that the univariate model with GK gives low R-indicators, with main causes GK groups 1 and 2. These 2 GK groups are again the main contributors of the low R-indicators for virtually all VAT groups. When we look at table 3.2 we can also see that for the univariate model with GK the response was more representative in the earlier stages of the survey. Small businesses tend to respond in the earlier stages of the survey, if a longer period of time has passed the smaller businesses often do not respond. For the univariate model with VAT we see that the R-indicators increase over time. This explains why the R-indicator of the multivariate model GK x VAT 9 is relatively constant over time and does not approach 1. For the remainder of the variables the R-indicators increase moderately over time.

We look at table 3.5 and 3.6 which contains the bootstrap confidence intervals of the chosen models for the STS. We see that the 95% confidence intervals of the models give approximately an error of 0.02 for the bootstrap mean. From this we can conclude that the R-indicators are sufficiently precise. However because the R-indicator is an estimator it could be biased, in this paper we will assume that a possible bias of the R-indicator is of little or no influence. Bias can be introduced through model selection, if an appropriate model is selected the bias should be of little or no influence.

Figure 4.1 Indexes of STS and VAT revenues of industrial businesses where KS is formula (13), KS NA formula (14), VAT formula (15), VAT NR formula (16)



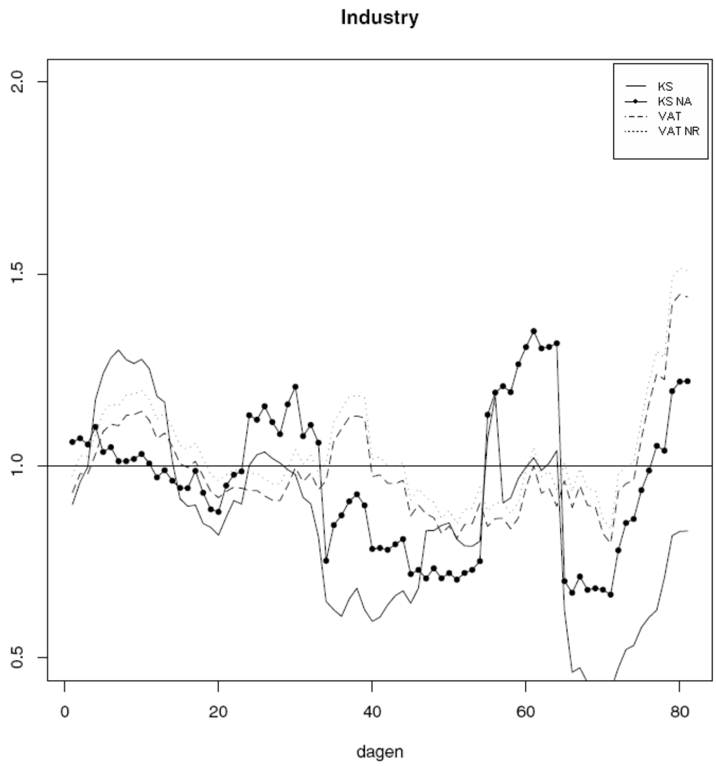
In order to investigate whether R-indicator paths in time resembles bias patterns, we employ indexes (13) to (16). In figures 4.1 and 4.3 we depict the indexes for industry and retail. For industry we can see that there is a difference between the STS revenue and the STS revenue with VAT group 1 (no VAT available) removed. In appendix H we can find a table with R-indicators where VAT group 1 was removed.

In Figure 4.1 we can see that prior to 20 days the index is more volatile in comparison to the remaining days. Thus we can conclude that after 20 days the mean slowly starts to approach 1.

In figure 4.2 we plotted the moving average of 10 days against the total mean. From this figure we can get an indication of the response in specific periods in time. For industry we cannot see a specific pattern of the response. At some points in time the mean of the target variable is lower in comparison to the total mean and at other times it is higher. Hence response does not depend strongly on type of business, size of business or VAT turnover.

In figure 4.3 and 4.4 we can see the same type of figures as figures 4.1 and 4.2, but in this case for retail. In figure 4.3 we can see that prior to 25 days the figure is more volatile in comparison to the remaining days. Again the mean slowly approaches 1 after 25 days.

Figure 4.2 Indexes of STS and VAT revenues where KS is the moving average of formula (13) (see section 2.2.3), KS NA moving average of formula (14), VAT moving average of formula (15), VAT NR moving average of formula (16)

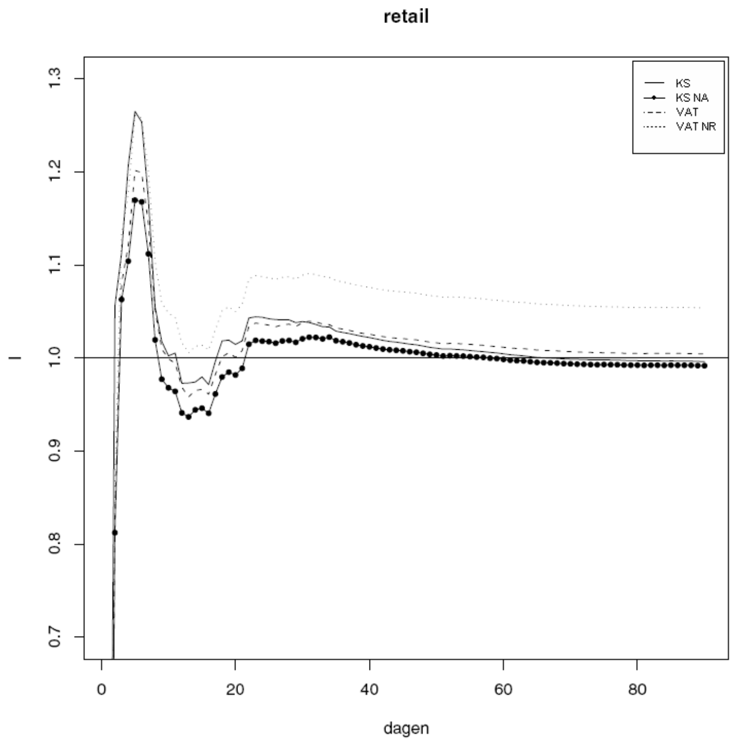


In figure 4.4 we can see that the response seems to show a discrepancy in response time between big and small revenues. After 30 days the mean response appears to be lower in comparison to the days before. We can conclude that after 30 days a large proportion of the response received consists of smaller businesses. Hence there are differences in the response rates for type of business, size of business or VAT turnover.

We can say that the R-indicator behaves as expected. When response between stratums deviate, the R-indicator is smaller in comparison to the R-indicator with stratums with approximately equal response rates.

From figures 4.2 and 4.4 we can determine whether there is a difference between early and late response. In figure 4.2 we can see that the response received remains highly volatile through time. From this we can conclude that no difference between early and late response. Otherwise a pattern would be present where late response would either be higher or lower than early response. In figure 4.4 we can see the moving average of the indexes for retail. We can see that contradictory to industry here the response clearly follows a pattern. Late respondents (after 30 days) tend to have lower revenues in comparison to earlier respondents.

Figure 4.3 Indexes of STS and VAT revenues of retail trade where KS is formula (13), KS NA formula (14), VAT formula (15), VAT NR formula (16)

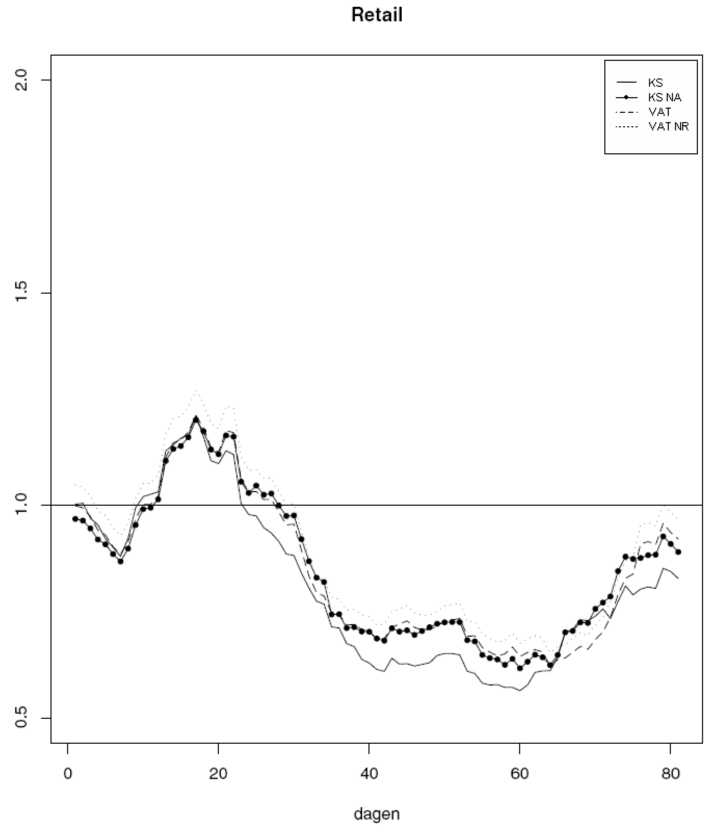


In figures 4.1 and 4.3 we show index (16). This index represents the weighted proportion of VAT revenue reported by STS respondents versus VAT revenue reported by all businesses in the STS sample. This index need not converge to 1 as respondents and non-respondents may report different revenues. Ideally, the paths of the R-indicator in time are similar to this index. In other words the R-indicator should detect differences between respondents and non-respondents. We must remark that index (16) is computed for all businesses with VAT linked, while the R-indicator is computed for all businesses. This has implications for the comparison between retail and industry as linkage errors concern mostly larger businesses.

From figures 4.1 and 4.3 we can conclude that index (16) converges to 1.05 for both industry and retail. We can, therefore, conclude that some bias remains after 90 days of fieldwork which also follows from the R-indicator. The convergence for retail is slower; after 60 days the index has already converged for industry but not yet for retail. The indexes for industry and retail do not confirm the R-indicators; the indexes do not show a larger difference between respondents and non-respondents for retail compared to industry. The index does confirm that bias tends to be smaller when time passes as also followed from the R-indicators.

We may also compare index (16) (figure 4.1 and 4.3 for industry and retail) to (8) (figures 3.1 and 3.2 for industry and retail). This time levels need not be the same as (8) reflects the maximal absolute bias under the worst case scenario. True bias may of course be smaller than this upper bound. Index (16) and (8) have a similar pattern in time. The differences between retail and industry are not found. Retail shows a considerably larger maximal bias while index (16) is similar to industry.

Figure 4.4 Indexes of STS and VAT revenues of retail trade where KS is the moving average of formula (13), KS NA the moving average of formula (14), VAT the moving average of formula (15), VAT NR the moving average of formula (16)



5. Representativity as a function of time

In this chapter we will focus on the time needed for the survey to become sufficiently representative for the population. In order to do so we investigate the impact of non-response in time. The R-indicator is an estimator from which we should be able to determine the diversity of response between different sub stratums. With help of the R-indicator we can determine the maximal bias on estimates. Bias is ultimately caused by differences in response between stratums and the deviation of the target variable. Therefore we want to know how the revenue of the target variable behaves as a function of time.

In order to determine the representativity we first need to make realistic choices on what accuracy is expected. In figures 3.1 and 3.2 we saw several response-representativity functions based on the minimal bias levels 0.01, 0.05, 0.1, 0.15 and 0.2. The first bound is aiming too high; in our study none of our models ever reached this bound. The remaining bounds however are more realistic especially for industry. We can see in figure 3.1 that after 10 days the bounds γ=0.1, γ=0.15 and γ=0.2 are all reached for industry. The Bound γ=0.05 is reached after 32 days. This bound is probably the most realistic for the industry as the model does not show much improvement after this point.

From figures 4.1 and 4.3 we have seen the fluctuations in the response. As the number of respondents increases, the effects of newly added respondents decrease. We can see that after 20 days the effects on the mean start to dissipate for the industry. We conclude that for industry we can start publishing somewhere between 30 and 35 days.

For retail we can see that none of the bounds specified above are reached within the time span of 60 days. However after approximately 30 days the minimal bias bound γ=0.25 is reached. If we look at figure 4.3 we can see that the mean in this case starts to dissipate again around 20 days. We conclude that for the retail the response does not become representative enough according to our pre-described bounds. Given the lower bound of γ=0.25 we can start to publish after 30 days, however because this would give a considerable bias it would be best to wait until 60 days after the deployment of the survey before publishing. We recommend focusing on improving the representativity for retail trade. Under-represented stratums in the survey can be given reminders to respond thereby possibly improving response.

6. Mode of Data Collection

In this chapter we will analyse the different modes of data collection and determine if there is a discrepancy between these methods. We will start by looking at the univariate logistic regression model with mode of data collection as the predictor followed by R-indicators for electronic and paper surveys.

From figures 6.1 and 6.2 we can conclude that mode of data collection has a difference in response for the different modes as well as for industry as for retail. Therefore we calculated the R-indicators for the various modes of data collection separately. In this chapter we will only discuss electronic versus paper surveys, however in Appendix G electronic surveys are also separated into electronic modes that received the log in codes via paper and e-mail.

The methods are difficult to compare to one another because of the fact that businesses have the possibility to choose between the modes. Therefore any discrepancy we notice is likely to be caused by the fact that different types and sizes of businesses choose different modes. However looking at table 6.1 we can see that the R-indicators do not differ as much as the response. From this we can conclude that although the response seems to be slower for paper in comparison to the electronic mode, the representativity is not different for the industry. A more thorough look with other R-indicators can be found in Appendix G.

Figure 6.1 R-indicator of the mode of data collection for industry against days. Where points represent the R-indicator values, top and bottom lines represent the bootstrap 95% confidence interval, and the remaining line is the bootstrap mean.

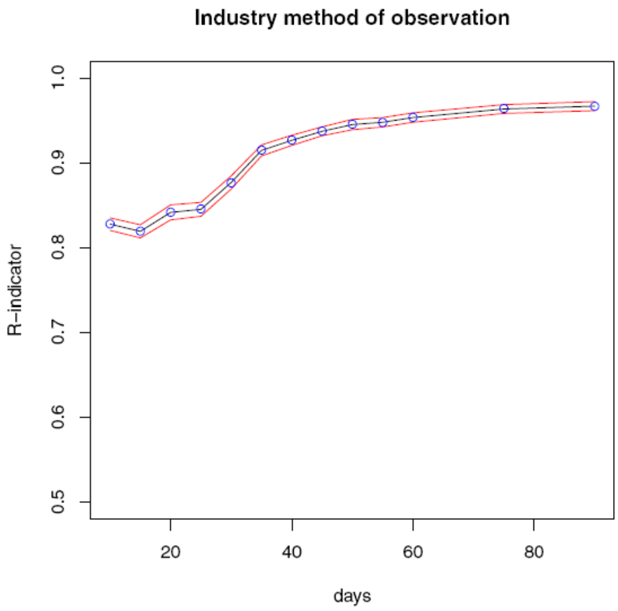
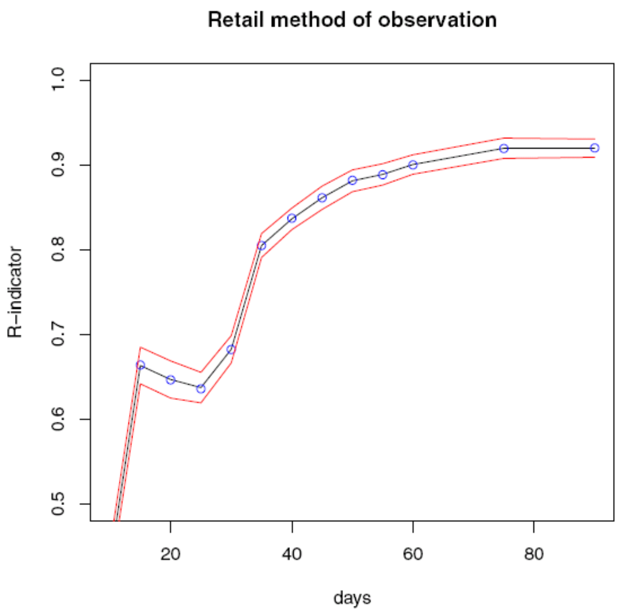


Figure 6.2 R-indicator of the Mode of data collection for retail against days. Where points represent the R-indicator values, top and bottom lines represent the bootstrap 95% confidence interval, and the remaining line is the bootstrap mean.



For the retail trade in table 6.2 we can see that again paper surveys respond slower in comparison to electronic surveys. However the difference with industry is that there is a significant difference between the representativeness of paper and electronic surveys. The R-indicators of retail show a significantly lower representativity for paper questionnaires, thus the mode of data collection affect the representativity for retail. For reasons stated earlier in this chapter we cannot use the mode of data collection in the logistic regression model. However we can try to improve the representativity of the response between the different questionnaires.

Table 6.1 R-indicators of Paper v Electronic mode of data collection for Industry.

model	15d	30d	45d	60d	tot
perc response received paper	0,33	0,68	0,80	0,85	0,91
R-ind GKxVAT 9 groups paper	0,938	0,932	0,937	0,944	0,947
perc resp. received electronic	0,53	0,82	0,87	0,89	0,93
R-ind GKxVAT Electronic	0,922	0,928	0,932	0,932	0,930

Table 6.2 R-indicators of Paper v Electronic mode of data collection for retail

model	15d	30d	45d	60d	tot
perc. response Paper	0,45	0,74	0,84	0,87	0,91
R-ind GK x VAT 9 groups Paper	0,517	0,511	0,490	0,518	0,565
R-ind SBI Paper	0,504	0,551	0,640	0,669	0,722
perc. response Electronic	0,55	0,83	0,88	0,90	0,94
R-ind GK x VAT 9 groups Electronic	0,739	0,769	0,783	0,782	0,767
R-ind SBI Electronic	0,602	0,729	0,756	0,776	0,804

7. Representativity of different survey months

In this chapter we will describe the differences in response that occur between months. We will describe the months that give the least representative response. In table 7.1 we can see the R-indicators for the different months for the model GK x VAT. We have to comment that this model is slightly different from the model in chapter 3 because of the fact that some strata needed to be collapsed to ensure sufficient cell sizes. This means that in general R-indicators will be somewhat larger, but we can compare the different survey months.

From table 7.1 we can see that some months result in lower R-indicators. The month November gives the lowest R-indicator for industry if we look at the final response received. This can be explained by the fact that the revenue of the month November will be received by a survey in the month December. As this is a holiday period this most likely explains the discrepancy. After 60 days we can see that November and April give the lowest R-indicators and after 30 days the months January and February give the lowest R-indicators. We can conclude for industry that the months January and February need more time to become representative, whereas the months April and November give the lowest R-indicators. March is the best month when considering the representativity.

If we look at table 7.2 we can see that for retail the month November is again the most troublesome when the total response has been received. However we can see that also the month August is causing some trouble. The best months are February and March. After 60 days we can see that the worst months are still November and August. However April is now significantly lower than for the total response. After 30 days we can see that March and May are the best responding months when considering the representativity. The month November is still the worst responding month. However we have to notice that the difference after 30 days is smaller in comparison with the R-indicators after 60 days and the total response.

Table 7.1 Industry R-indicators for months for different times.

Model	Month	15d	30d	45d	60d	tot
GKxVAT9 *	Jan	0,897	0,887	0,916	0,922	0,925
	Feb	0,866	0,899	0,921	0,930	0,922
	Mar	0,902	0,931	0,939	0,937	0,933
	Apr	0,896	0,916	0,911	0,915	0,932
	May	0,874	0,916	0,921	0,925	0,930
	Jun	0,895	0,918	0,921	0,933	0,930
	Jul	0,856	0,907	0,925	0,927	0,927
	Aug	0,921	0,916	0,922	0,921	0,927
	Sep	0,898	0,916	0,925	0,930	0,940
	Okt	0,904	0,908	0,926	0,929	0,932
	Nov	0,895	0,902	0,905	0,907	0,918
	Dec	0,926	0,908	0,932	0,934	0,934

For both retail and industry we conclude that the month November has less representative response than other months. March on the other hand is more representative than most other months. Furthermore it seems to be the month that will be representative after the least number of days. From this we can conclude that seasonal effects are present in the STS for both retail and industry.

Table 7.2 Retail R-indicators for months for different times.

Model	Month	15d	30d	45d	60d	tot
GKxVAT9 *	Jan	0,493	0,522	0,577	0,609	0,657
	Feb	0,526	0,602	0,639	0,718	0,730
	Mar	0,655	0,669	0,711	0,722	0,731
	Apr	0,577	0,579	0,567	0,597	0,689
	May	0,671	0,663	0,650	0,708	0,688
	Jun	0,668	0,579	0,566	0,600	0,626
	Jul	0,624	0,590	0,614	0,606	0,621
	Aug	0,584	0,577	0,572	0,579	0,599
	Sep	0,559	0,574	0,580	0,601	0,659
	Okt	0,593	0,552	0,595	0,609	0,618
	Nov	0,586	0,516	0,507	0,513	0,567
	Dec	0,559	0,596	0,595	0,601	0,615

8. Stratums in need of improvement

In this chapter we will describe the stratums that potentially attribute the most to bias in estimates. This information can be used to try to improve the response by focussing on these stratums when reminders are sent to non-responding businesses. In Table 8.1 we see the estimates with the standard deviations of the logistic regression model GK x VAT 9 for industry. Every column represents a different point in time, whereas the rows represent the stratums of the logistic regression model. Thus, the underlined values represent the estimate and the standard deviation (between brackets) of the stratum GK 6 and VAT 3 after 60 days. A negative estimate implies underrepresentation with respect to the reference group. The statistical significance of the under or over representation is reflected by the standard error.

Table 3.1 Estimates and standard deviations of the logistic regression model GkxVAT9 for industry. The reference group is GK 5 with VAT group 1.

	15d Estimate (std. Err.)			30d Estimate (std. Err.)			45d Estimate (std. Err.)			60d Estimate (std. Err.)			tot Estimate (std. Err.)		
(Intercept)	-0,157	(0,019)	***	1,139	(0,022)	***	1,650	(0,026)	***	1,878	(0,028)	***	2,364	(0,034)	***
GK 5 Vat G2	-0,127	(0,036)	***	-0,091	(0,041)	*	-0,197	(0,046)	***	-0,233	(0,049)	***	**-0,381**	**(0,057)**	*******
GK 5 VAT G3	-0,038	(0,035)		0,038	(0,041)		-0,033	(0,047)		-0,091	(0,051)	,	**-0,218**	**(0,059)**	*******
GK 5 VAT G4	0,054	(0,035)		0,104	(0,042)	*	0,014	(0,048)		-0,034	(0,052)		-0,145	(0,061)	*
GK 5 VAT G5	0,134	(0,037)	***	0,212	(0,045)	***	0,136	(0,052)	**	0,103	(0,056)	,	-0,008	(0,066)	
GK 5 VAT G6	0,166	(0,040)	***	0,267	(0,050)	***	0,201	(0,058)	***	0,168	(0,063)	**	0,075	(0,074)	
GK 5 VAT G7	0,108	(0,048)	*	0,133	(0,057)	*	0,019	(0,065)		0,024	(0,071)		0,021	(0,086)	
GK 5 VAT G8	0,313	(0,065)	***	0,410	(0,085)	***	0,396	(0,100)	***	0,384	(0,110)	***	0,175	(0,124)	
GK 5 VAT G9	0,197	(0,102)	,	0,027	(0,119)		-0,116	(0,133)		-0,239	(0,138)	,	-0,323	(0,160)	*
GK 6 VAT G1	-0,070	(0,034)	*	-0,034	(0,039)		0,013	(0,046)		-0,001	(0,049)		-0,015	(0,059)	
GK 6 VAT G2	0,224	(0,112)	*	-0,186	(0,125)		-0,367	(0,136)	**	-0,365	(0,146)	*	**-0,476**	**(0,167)**	******
GK 6 VAT G3	-0,485	(0,149)	**	-0,386	(0,152)	*	-0,635	(0,161)	***	**-0,622**	**(0,171)**	*******	**-0,651**	**(0,198)**	******
GK 6 VAT G4	0,022	(0,104)		0,171	(0,126)		0,103	(0,146)		0,122	(0,160)		0,184	(0,199)	
GK 6 VAT G5	0,016	(0,077)		-0,046	(0,088)		-0,052	(0,103)		-0,022	(0,112)		-0,029	(0,135)	
GK 6 VAT G6	0,084	(0,058)		0,157	(0,070)	*	0,021	(0,079)		0,089	(0,088)		0,136	(0,108)	
GK 6 VAT G7	0,117	(0,049)	*	0,179	(0,060)	**	0,126	(0,069)	,	0,201	(0,077)	**	0,127	(0,091)	
GK 6 VAT G8	0,208	(0,051)	***	0,324	(0,065)	***	0,237	(0,075)	**	0,236	(0,082)	**	0,162	(0,097)	,
GK 6 VAT G9	0,157	(0,075)	*	0,367	(0,097)	***	0,320	(0,113)	**	0,426	(0,129)	***	0,761	(0,184)	***
GK 7 VAT G1	0,295	(0,040)	***	0,408	(0,051)	***	0,548	(0,064)	***	0,672	(0,073)	***	1,349	(0,120)	***
GK 7 VAT G6	-0,178	(0,160)		-0,081	(0,180)		-0,033	(0,212)		-0,072	(0,227)		0,168	(0,302)	
GK 7 VAT G7	0,199	(0,087)	*	0,411	(0,113)	***	0,346	(0,132)	**	0,422	(0,149)	**	0,699	(0,207)	***
GK 7 VAT G8	0,336	(0,053)	***	0,498	(0,070)	***	0,462	(0,083)	***	0,578	(0,095)	***	1,149	(0,150)	***
GK 7 VAT G9	0,422	(0,055)	***	0,615	(0,076)	***	0,668	(0,092)	***	0,898	(0,112)	***	1,725	(0,201)	***
GK 8	**0,501**	**(0,037)**	*******	**0,738**	**(0,051)**	*******	**0,896**	**(0,064)**	*******	**1,008**	**(0,075)**	*******	**1,863**	**(0,133)**	*******
GK 9	**0,430**	**(0,056)**	*******	**0,956**	**(0,085)**	*******	**1,169**	**(0,109)**	*******	**1,362**	**(0,136)**	*******	**1,982**	**(0,226)**	*******
GK 7 VAT G2-5	-0,269	(0,185)		-0,125	(0,204)		-0,273	(0,225)		-0,169	(0,251)		0,184	(0,348)	

Significance codes

***	0,001	*	0,05
**	0,01	,	0,1

Table 3.2 Estimates and standard deviations for the logistic regression model GK x VAT9 for Retail. The reference group is GK 6.

	15d Estimate (Std. Err.)		30d Estimate (Std. Err.)		45d Estimate (Std. Err.)		60d Estimate (Std. Err.)		tot Estimate (Std. Err.)	
Intercept	0,046 (0,045)		1,742 (0,063)	***	2,330 (0,079)	***	2,660 (0,091)	***	3,670 (0,144)	***
GK 7	0,170 (0,078)	*	0,230 (0,115)	*	0,420 (0,154)	**	0,508 (0,184)	**	1,150 (0,356)	**
GK8	0,101 (0,102)		0,425 (0,162)	**	1,500 (0,305)	***	2,101 (0,474)	***	2,894 (0,755)	***
GK9	0,626 (0,106)	***	1,875 (0,236)	***	2,489 (0,392)	***	3,217 (0,643)	***	2,206 (0,653)	***
GK 1 BTW G1	-0,481 (0,053)	***	-1,165 (0,069)	***	-1,403 (0,085)	***	-1,568 (0,096)	***	-2,296 (0,148)	***
GK 2 BTW G1	-0,405 (0,050)	***	-1,004 (0,067)	***	-1,151 (0,083)	***	-1,299 (0,095)	***	-1,948 (0,147)	***
GK 3 BTW G1	-0,192 (0,059)	**	-0,518 (0,078)	***	-0,543 (0,096)	***	-0,647 (0,108)	***	-0,759 (0,168)	***
GK 4 BTW G1	-0,446 (0,069)	***	-0,616 (0,087)	***	-0,490 (0,109)	***	-0,594 (0,122)	***	-0,963 (0,179)	***
GK 5 BTW G1	-0,072 (0,065)		-0,285 (0,087)	**	-0,241 (0,109)	*	-0,301 (0,124)	*	-0,489 (0,188)	**
GK 1 BTW G2	0,220 (0,053)	***	-0,424 (0,072)	***	-0,590 (0,088)	***	-0,754 (0,100)	***	-1,450 (0,152)	***
GK 2 BTW G2	-0,041 (0,057)		-0,749 (0,074)	***	-0,923 (0,090)	***	-1,130 (0,102)	***	-1,918 (0,152)	***
GK 3 BTW G2	-0,209 (0,208)		-0,776 (0,235)	***	-0,838 (0,273)	**	-1,026 (0,288)	***	-0,940 (0,445)	*
GK 4 BTW G2	-0,046 (0,276)		-0,594 (0,324)	,	-0,720 (0,374)	,	-0,756 (0,415)	,	-0,412 (0,735)	
GK 5 BTW G2	0,082 (0,296)		-0,158 (0,393)		-0,201 (0,480)		0,026 (0,604)		-0,557 (0,737)	
GK 4 BTW G3-4	-0,425 (0,258)		-0,376 (0,317)		-0,384 (0,386)		-0,192 (0,475)		-0,658 (0,609)	
GK 5 BTW G3-5	-0,234 (0,255)		0,068 (0,365)		0,378 (0,521)		0,774 (0,723)		2,894 (2,028)	
GK 1 BTW G3	0,065 (0,053)		-0,492 (0,072)	***	-0,605 (0,088)	***	-0,734 (0,100)	***	-1,381 (0,152)	***
GK 2 BTW G3	0,148 (0,056)	**	-0,404 (0,075)	***	-0,473 (0,093)	***	-0,560 (0,105)	***	-1,204 (0,157)	***
GK 3 BTW G3	-0,269 (0,241)		-0,568 (0,284)	*	-0,250 (0,383)		-0,262 (0,436)		-0,535 (0,607)	
GK 1 BTW G4	-0,010 (0,058)		-0,535 (0,077)	***	-0,583 (0,095)	***	-0,671 (0,107)	***	-1,256 (0,159)	***
GK 2 BTW G4	0,114 (0,052)	*	-0,368 (0,071)	***	-0,413 (0,089)	***	-0,514 (0,101)	***	-1,068 (0,153)	***
GK 3 BTW G4	-0,451 (0,142)	**	-0,701 (0,163)	***	-0,710 (0,194)	***	-0,463 (0,238)	,	-0,209 (0,410)	
GK 1 BTW G5	0,226 (0,074)	**	-0,195 (0,099)	*	-0,195 (0,123)		-0,344 (0,136)	*	-1,066 (0,184)	***
GK 2 BTW G5	0,075 (0,051)		-0,318 (0,070)	***	-0,271 (0,088)	**	-0,394 (0,100)	***	-1,032 (0,152)	***
GK 3 BTW G5	-0,160 (0,086)	,	-0,343 (0,111)	**	-0,228 (0,141)		-0,317 (0,158)	*	-0,119 (0,264)	
GK 4 BTW G5	-0,413 (0,254)		-0,337 (0,316)		-0,484 (0,367)		-0,357 (0,438)		-0,929 (0,536)	,
GK 1 BTW G6	0,127 (0,107)		-0,512 (0,132)	***	-0,643 (0,155)	***	-0,824 (0,167)	***	-1,599 (0,210)	***
GK 2 BTW G6	0,013 (0,052)		-0,388 (0,071)	***	-0,348 (0,089)	***	-0,449 (0,101)	***	-1,033 (0,154)	***
GK 3 BTW G6	0,044 (0,061)		-0,213 (0,083)	*	-0,019 (0,106)		0,029 (0,124)		0,434 (0,215)	*
GK 4 BTW G6	-0,011 (0,138)		-0,307 (0,177)	,	-0,250 (0,223)		-0,343 (0,246)		0,672 (0,582)	
GK 5 BTW G6	-0,228 (0,251)		-0,519 (0,300)	,	-0,720 (0,340)	*	-0,937 (0,355)	**	-0,929 (0,536)	,
GK 1 BTW G7	0,039 (0,162)		-0,603 (0,192)	**	-0,559 (0,235)	*	-0,788 (0,246)	**	-1,570 (0,288)	***
GK 2 BTW G7	0,062 (0,058)		-0,302 (0,078)	***	-0,290 (0,098)	**	-0,405 (0,110)	***	-1,091 (0,161)	***
GK 3 BTW G7	-0,070 (0,054)		-0,268 (0,074)	***	-0,134 (0,094)		-0,136 (0,108)		0,011 (0,174)	
GK 4 BTW G7	-0,134 (0,078)	,	-0,500 (0,099)	***	-0,460 (0,123)	***	-0,504 (0,139)	***	-0,620 (0,211)	**
GK 5 BTW G7	-0,468 (0,154)	**	-0,376 (0,190)	*	0,002 (0,266)		-0,037 (0,301)		-0,049 (0,474)	
GK 1 BTW G8-9	0,210 (0,276)		0,183 (0,409)		0,523 (0,596)		0,617 (0,726)		-0,393 (0,734)	
GK 2 BTW G8	0,081 (0,080)		-0,111 (0,109)		-0,196 (0,133)		-0,291 (0,148)	*	-0,838 (0,203)	***
GK 3 BTW G8	0,008 (0,057)		-0,118 (0,079)		-0,070 (0,099)		-0,197 (0,112)	,	-0,381 (0,172)	*
GK 4 BTW G8	-0,145 (0,057)	*	-0,269 (0,077)	***	-0,161 (0,098)	,	-0,233 (0,111)	*	-0,248 (0,175)	
GK 5 BTW G8	-0,373 (0,077)	***	-0,379 (0,100)	***	-0,189 (0,129)		-0,206 (0,147)		-0,123 (0,237)	
GK 2 BTW G9	-0,295 (0,178)	,	-0,193 (0,233)		-0,074 (0,302)		-0,221 (0,327)		-1,232 (0,346)	***
GK 3 BTW G9	-0,138 (0,104)		0,086 (0,150)		0,095 (0,189)		-0,144 (0,200)		-0,537 (0,275)	,
GK 4 BTW G9	-0,102 (0,066)		-0,158 (0,090)	,	0,080 (0,119)		0,020 (0,135)		0,220 (0,224)	
GK 5 BTW G9	-0,178 (0,056)	**	-0,099 (0,078)		-0,068 (0,098)		-0,138 (0,112)		-0,288 (0,173)	,

Significance codes:
*** 0,001   * 0,1
** 0,01   , 0,1

We can see that for the industry the stratums GK 8 and 9 are among the best responding stratums for all days in the table. As these stratums seem to respond much better in comparison to other stratums, we can state that we do not need to improve the representativity of these stratums for any of the days. GK stratum 7 also does not need much improvement as most of these stratums are either better or not significantly different than other stratums.

Stratums that respond significantly worse than the reference group for the total response are GK groups 5 and 6 with VAT groups 2 and 3. However if we look after 60 days we see that the significance is reduced for some of these stratums.

In table 8.2 we can see that the estimates for retail show that GK stratums 1 and 2 have significantly lower response in the different days in comparison to other stratums. Furthermore we can see that the stratum of GK 9 is always responding significantly better in comparison to other stratums. The stratums GK 7 and 8 responded significantly better for all days with exception of GK 8 after 15 days. VAT stratum 1, which is the stratum for which no VAT was present, also shows a significantly lower estimate for retail.

We can conclude that small businesses respond worse than larger businesses and in case of retail businesses that did not have VAT also were responding significantly worse. A possible cause of the lower response for smaller businesses is the fact that smaller businesses are not aware of the compulsory nature of the survey and therefore choose not to respond. Another reason could be that new businesses are unfamiliar to the questions asked and might not respond because they do not know the answer. As new businesses are mostly small businesses there would be a small difference in response.

We also calculated the estimates with SBI 2 digits for industry and SBI without separation for retail these can be found in appendix J.

9. Conclusions and Recommendations

9.1 Conclusions

In this paper we answered several research questions about the representativeness of the Short Term Statistics (STS). In section 1.1 several research questions were presented, we will follow these questions in presenting the conclusions.

The first question that needed answering was which of the available variables may be used in the logistic regression model? (§3.1-3.3) We concluded that the mode of data collection and the month of interview should not be included in the logistic regression model. However we concluded that the remaining variables SBI, VAT and business size could be used. However to use the variables they sometimes needed some alteration. For SBI we needed to prune the variable and for VAT we needed separation into several groups. This because a large proportion of the businesses in the STS could not be linked with VAT.

The second question in this paper was how to estimate response probabilities using the available auxiliary variables? (§3.4) We compared several multiple variable models to draw a conclusion on the best logistic regression model for measuring representativeness of the STS. We presented several criteria which were used to determine the best model. In our research we looked at two distinct groups within the STS; manufacturing industry and retail trade. We concluded that a logistic regression model with variables GK and VAT resulted in the best model for both retail trade and manufacturing industry.

After determining the best model we needed to research whether the R-indicator was suitable for measuring bias in the response of STS? (H4) We looked at the R-indicator and determined if this measure for the representativity could be used for the STS. We found that the R-indicator gave a good indication of the representativity and can be used to see when a survey becomes representative. Furthermore the chosen logistic regression model resulted in small confidence intervals, therefore the R-indicator has a small standard error for the STS.

The next question was whether there was a discrepancy between "early" and "late" response for industry or retail trade? (H4) We found that for retail trade the response was very different for early and late response. For retail late response tended to consist of mainly smaller businesses. Manufacturing industry did not give a difference in early and late respondents.

Using the earlier specified model we wanted to determine how many days the STS needed to become representative for industry and retail? (H5) We concluded that the moment the industry becomes representative enough for publication is between 30 and 35 days after the deployment of the survey. The representativity does not seem to increase significantly in the days after this point. For retail we saw that representativity did not pass the prescribed bounds. However if we have to give the best moment for publication we would have to say around 60 days.

Statistics Netherlands was interested in whether differences occurred in the representativeness of the different modes of data collection (paper / electronic (html)? (H6) Looking at the mode of data collection we conclude that for industry as well as for retail the response was slower for paper surveys. However when looking at the representativity of electronic and paper modes of data collection we came to the conclusion that although paper was worse for industry, the difference was not significant. For retail we did see a difference between the representativity of paper and electronic mode, with the latter being the better.

Another question was whether discrepancies existed for the different months of the year? (H7) We investigated the STS for seasonality. We came to the conclusion that the STS does show a seasonal effect for the representativity. The response of the month March was more representative than most other months and became representative faster than other months. The month November on the other hand was the least representative month. These effects were found for both retail and industry.

The final question was what subpopulations in the STS should receive more attention in order to improve the representativity of the response? (H8) The stratums for retail that caused the most discrepancy were GK groups 1 and 2. Another stratum that caused part of the discrepancy was the VAT group for which no VAT was present. Industry does not need much improvement, however if I had to recommend which stratums to improve I would recommend stratums with sizes of business group 5. For both retail and industry smaller businesses respond less than larger businesses.

9.2 Recommendations

The best model for the STS groups retail and industry was a model with GK and VAT. Using this model we came across some strata that needed improvement. If the choice is made to try to improve the representativity of the STS, we recommend focusing on retail as this group showed the least representative response. Especially GK groups 1 and 2 seem to cause less representative response for all VAT groups.

The STS furthermore showed that certain Months show a deviance from other months in terms of representativity. We recommend investigating if the differences found in the representativity can be reduced.

The R-indicator is a good measure for the representativity. This measure can be used to detect differences in response rates of stratums. However in my opinion the R-indicator should only be used in combination with other measures, the accuracy of estimates is also influenced by factors like the standard deviation of the target variable.

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Appendixes

Appendix A

Example data file of the STS and Statistical Business Register

BE ID	Enquete ID	SBI	GK	OPGAVE ID	OPGAVE STATUS	STATISTIEK JAAR	OPGAVE PERIODE	vARIABELE NAAM	WAARDE	Datum Tijd ontvangst	Waarneem medium
18313124	IMPMD	34201	6	36759449	8	2007	11	OMZETKS210000	596.000	8-5-2007 10:34:26	HE
10054448	IMPMD	2956	6	36780812	8	2007	11	OMZETKS210000	2280.000	8-5-2007 14:16:08	HE
36355097	IMPMD	2811	9	36847607	8	2007	11	OMZETKS210000	3412.000	9-5-2007 9:12:55	HE
18305652	IMPMD	2212	8	36721565	8	2007	11	OMZETKS210000	.000	9-5-2007 12:10:44	HE
10674942	IMPMD	21211	5	36763888	8	2007	11	OMZETKS210000	334.000	15-5-2007 15:16:04	S
13764969	IMPMD	93022	1	36824704	8	2007	11	OMZETKS100000	1.000	15-5-2007 10:49:48	S
35123621	IMPMD	55302	2	36819662	8	2007	11	OMZETKS100000	11.000	15-5-2007 9:59:36	S
10056742	IMPMD	34202	7	36962538	8	2007	11	OMZETKS210000	2904.000	14-5-2007 16:40:26	HE
10450890	IMPMD	2211	5	36766895	8	2007	11	OMZETKS210000	1205.000	15-5-2007 7:56:46	S
21357706	IMPMD	93022	1	36857661	8	2007	11	OMZETKS100000	4.000	27-2-2007 8:50:24	S
32373201	IMPMD	93022	1	36856711	8	2007	11	OMZETKS100000	1.000	27-2-2007 8:50:32	S
35339004	IMPMD	93022	1	36815462	8	2007	11	OMZETKS100000	.000	27-2-2007 8:50:42	S
37545671	IMPMD	55101	2	36862118	8	2007	11	OMZETKS100000	28.000	10-5-2007 10:35:22	S
12421367	IMPMD	55101	5	36953571	8	2007	11	OMZETKS100000	84.000	11-5-2007 15:38:17	S

Appendix B

The following Table gives the classes for size of business(GK). The second column is the range of employees the business needs to employ to be assigned to the business class in the first Column. Thus to be in class 2 the business needs to employ 2 to 4 employees.

GK (size of business in classes)	No. Of employees
0	0
1	1
2	2 - 4
3	5 -9
4	10 - 19
5	20 - 49
6	50 - 99
7	100 - 199
8	200 - 499
9	> 500

Appendix C

This table gives the categorization of businesses according to their main economic activity. Every Number represents an SBI category, followed by its description. For retail we describe SBI with 4 digits and for industry with 3 digits.

Industry SBI 3 digits

15	Vervaardiging van voedingsmiddelen en dranken	281	Vervaardiging van metalen constructiewerken, ramen,
151	Slachterijen en vleesverwerking		deuren en kozijnen
152	Visverwerking	282	Vervaardiging van tanks en reservoirs en van ketels en
153	Groente- en fruitverwerking		radiatoren voor de centrale verwarming
154	Vervaardiging van plantaardige en dierlijke oliën en vetten	283	Vervaardiging van stoomketels
155	Vervaardiging van zuivelproducten	284	Smeden, persen, stampen en
156	Vervaardiging van meel		profielwalsen van metaal; poedermetallurgie
157	Vervaardiging van diervoeder	285	Oppervlaktebehandeling en overige metaalbewerking
158	Vervaardiging van overige voedingsmiddelen	286	Vervaardiging van scharen en bestek,
159	Vervaardiging van dranken		gereedschap en hang- en sluitwerk
16	Verwerking van tabak	287	Vervaardiging van overige producten van metaal
160	Verwerking van tabak		(geen machines en transportmiddelen)
17	Vervaardiging van textiel	29	Vervaardiging van machines en apparaten
171	Bewerken en spinnen van textielvezels	291	Vervaardiging van machines voor de productie en
172	Weven van textiel		toepassing van mechanische energie
173	Textielveredeling		(geen motoren voor vliegtuigen, motorvoertuigen en -fietsen)
174	Vervaardiging van textielwaren (geen kleding)	292	Vervaardiging van overige machines en
175	Vervaardiging van overige textielproducten		apparaten voor algemeen gebruik
176	Vervaardiging van gebreide en gehaakte stoffen	293	Vervaardiging van landbouwmachines en -werktuigen
177	Vervaardiging van gebreide en gehaakte artikelen	294	Vervaardiging van gereedschapswerktuigen
18	Vervaardiging van kleding; bereiden en verven van bont	295	Vervaardiging van overige machines en
181	Vervaardiging van kleding van leer		apparaten voor specifieke industriële activiteiten
182	Vervaardiging van kleding en -toebehoren (geen kleding van leer)	296	Vervaardiging van wapens en munitie
183	Bereiden en verven van bont; vervaardiging van artikelen van bont	297	Vervaardiging van huishoudelijke apparaten
19	Vervaardiging van leer en lederwaren (geen kleding)	30	Vervaardiging van kantoormachines en computers
191	Looien en bewerken van leer	300	Vervaardiging van kantoormachines en computers
192	Vervaardiging van lederwaren (geen kleding en schoeisel)	31	Vervaardiging van overige elektrische machines,
193	Vervaardiging van schoeisel		apparaten en benodigdheden
20	Houtindustrie en vervaardiging van artikelen	311	Vervaardiging van elektromotoren
	van hout, kurk, riet en vlechtwerk (geen meubels)		en elektrische generatoren en transformatoren
201	Primaire houtbewerking	312	Vervaardiging van schakel- en verdeelinrichtingen
202	Vervaardiging van fineer en plaatmaterialen	313	Vervaardiging van geïsoleerde kabel en draad
203	Vervaardiging van timmerwerk	314	Vervaardiging van accumulatoren,
204	Vervaardiging van houten emballage		elektrische elementen en batterijen
205	Vervaardiging van overige artikelen van hout;	315	Vervaardiging van elektrische lampen en
	vervaardiging van artikelen van kurk, riet en vlechtwerk		buizen en van verlichtingsbenodigdheden
21	Vervaardiging van papier, karton en papier- en kartonwaren	316	Vervaardiging van overige elektrische benodigdheden n.e.g.
211	Vervaardiging van pulp, papier en karton	32	Vervaardiging van audio-,
212	Vervaardiging van papier- en kartonwaren		video- en telecommunicatieapparaten en -benodigdheden
22	Uitgeverijen, drukkerijen en reproductie van opgenomen media	321	Vervaardiging van elektronische componenten
221	Uitgeverijen	322	Vervaardiging van zendapparaten voor televisie en
222	Drukkerijen en aanverwante activiteiten		radio en van apparaten voor lijntelefonie en -telegrafie
223	Reproductie van opgenomen media	323	Vervaardiging van audio- en videoapparaten
23	Aardolie- en steenkoolverwerkende industrie;	33	Vervaardiging van medische apparaten en
	bewerking van splijt- en kweekstoffen		instrumenten, orthopedische artikelen
231	Vervaardiging van cokesovenproducten		e.d., precisie- en optische instrumenten en uurwerken
232	Aardolieverwerking	331	Vervaardiging van medische apparaten en
233	Bewerking van splijt- en kweekstoffen		instrumenten en orthopedische en protheseartikelen
24	Vervaardiging van chemische producten	332	Vervaardiging van meet-, regel- en controleapparaten
241	Vervaardiging van basischemicaliën		(niet voor de bewaking van industriële processen)
242	Vervaardiging van landbouwchemicaliën	333	Vervaardiging van apparaten voor de bewaking
243	Vervaardiging van verf, lak, vernis, inkt en mastiek		van industriële processen
244	Vervaardiging van farmaceutische producten	334	Vervaardiging van optische instrumenten,
245	Vervaardiging van zeep-, was-,		foto- en filmapparaten
	reinigings- en onderhoudsmiddelen, parfums en cosmetica	335	Vervaardiging van uurwerken
246	Vervaardiging van overige chemische producten	34	Vervaardiging van auto's, aanhangwagens en opleggers
247	Vervaardiging van synthetische en kunstmatige vezels	341	Vervaardiging van auto's
25	Vervaardiging van producten van rubber en kunststof	342	Carrosseriebouw en
251	Vervaardiging van producten van rubber		vervaardiging van aanhangwagens en opleggers
252	Vervaardiging van producten van kunststof	343	Vervaardiging van auto-onderdelen en -accessoires
26	Vervaardiging van glas, aardewerk, cement-, kalk- en gipsproducten	35	Vervaardiging van transportmiddelen
261	Vervaardiging van glas en glaswerk		(geen auto's, aanhangwagens en opleggers)
262	Vervaardiging van keramische producten	351	Scheepsbouw en -reparatie
	(geen producten voor de bouw)	352	Vervaardiging van rollend spoor- en tramwegmaterieel
263	Vervaardiging van keramische tegels en plavuizen	353	Vervaardiging van vlieg- en ruimtevaartuigen
264	Vervaardiging van keramische producten voor de bouw	354	Vervaardiging van fietsen,
	(geen tegels en plavuizen)		motor- en bromfietsen en invalidenwagens
265	Vervaardiging van cement, kalk en gips	355	Vervaardiging van overige transportmiddelen n.e.g.
266	Vervaardiging van producten van beton, cement en gips	36	Vervaardiging van meubels;
267	Natuursteenbewerking		vervaardiging van overige goederen n.e.g.
268	Vervaardiging van overige niet-metaalhoudende minerale producten	361	Vervaardiging van meubels
27	Vervaardiging van metalen in primaire vorm	362	Vervaardiging van sieraden e.d. (geen imitatie)
271	Vervaardiging van ijzer en staal en van ferro-legeringen	363	Vervaardiging van muziekinstrumenten
272	Vervaardiging van gietijzeren en stalen buizen	364	Vervaardiging van sportartikelen
273	Overige eerste verwerking van ijzer en staal	365	Vervaardiging van spellen en speelgoed
274	Vervaardiging van non-ferrometalen	366	Vervaardiging van overige goederen n.e.g.
275	Gieten van metalen	37	Voorbereiding tot recycling
28	Vervaardiging van producten van metaal	371	Voorbereiding tot recycling van metaalafval
	(geen machines en transportmiddelen)	372	Voorbereiding tot recycling van afval (geen metaalafval)

Retail SBI 4 digits

52	Detailhandel en reparatie van consumentenartikelen (geen auto's, motorfietsen en motorbrandstoffen)
521	Supermarkten, warenhuizen en dergelijke winkels met een algemeen assortiment
5211	Supermarkten en dergelijke winkels met een algemeen assortiment voedings- en genotmiddelen
5212	Warenhuizen en dergelijke winkels met een algemeen assortiment
522	Winkels gespecialiseerd in voedings- en genotmiddelen
5221	Winkels in aardappelen, groenten en fruit
5222	Winkels in vlees en vleeswaren, wild en gevogelte
5223	Winkels in vis
5224	Winkels in brood en banket, chocolade en suikerwerk
5225	Winkels in dranken
5226	Winkels in tabaksproducten
5227	Winkels in kaas, reformartikelen, buitenlandse voedingsmiddelen en voedings- en genotmiddelen n.e.g.
523	Winkels in farmaceutische en medische artikelen, parfums en cosmetica
5231	Apotheken
5232	Winkels in drogisterij- en medische artikelen
5233	Winkels in parfums en cosmetica
524	Winkels gespecialiseerd in overige artikelen
5241	Winkels in kledingstoffen, huishoudtextiel, breiwol, handwerken en fournituren
5242	Winkels in kleding en modeartikelen
5243	Winkels in schoeisel, lederwaren en reisartikelen
5244	Winkels in meubels, woningtextiel, verlichtings- en huishoudelijke artikelen
5245	Winkels in witgoed, bruingoed, telecommunicatieapparaten, geluidsdragers en muziekinstrumenten
5246	Winkels in ijzerwaren, gereedschappen, verf en bouwmaterialen (doe-het-zelfartikelen)
5247	Winkels in boeken, tijdschriften, kantoor- en schoolbenodigdheden
5248	Overige winkels (1)
5249	Overige winkels (2)
525	Winkels in tweedehands goederen en antiek
5250	Winkels in tweedehands goederen en antiek
526	Detailhandel niet in winkel
5261	Postorderbedrijven
5262	Markthandel
5263	Straathandel, colportage e.d.
527	Reparatie van consumentenartikelen (geen auto's en motorfietsen)
5271	Reparatie van schoeisel en lederwaren
5272	Reparatie van elektrische huishoudelijke apparaten
5273	Reparatie van uurwerken en juweliersartikelen
5274	Reparatie van consumentenartikelen n.e.g.

Appendix D

Here we describe the separation of the VAT revenues for retail and industry. The second column is the criteria used to separate the VAT into the classes of the first column.

Industry

VAT GROUP	Separated on revenues:	
1	No VAT available (NA)	
2		<= 161000
3	> 161000	<= 253000
4	> 253000	<= 365000
5	> 365000	<= 518000
6	> 518000	<= 783000
7	> 783000	<= 1283000
8	> 1283000	<= 2606000
9	> 2606000	

Retail

VAT GROUP	Separated on revenues:	
1	No VAT available (NA)	
2		<=526
3	> 526	<=4629
4	> 4629	<=11924
5	> 11924	<=22416
6	> 22416	<=38231
7	> 38231	<=66038
8	> 66038	<=132926
9	> 132926	

Appendix E

Tables with R-indicators of the logistic regression models, including bootstrap mean and confidence intervals.
Appendix E.1 consists of one variable models for industrial businesses
Appendix E.2 consists of one variable models for retail businesses
Appendix E.3 consists of multivariate models for industrial businesses
Appendix E.4 consists of multivariate models for retail businesses

APPENDIX E.1

R-indicators of one auxiliary variable models for industrial businesses

model		15d	30d	45d	60d	tot
percentage respons		0,49	0,79	0,86	0,88	0,92
mode of data collection	**Rind**	0,820	0,877	0,938	0,954	0,966
	Boot mean	0,820	0,877	0,938	0,948	0,966
	Boot min	0,811	0,870	0,932	0,954	0,961
	Boot max	0,829	0,884	0,944	0,960	0,970
GK	**Rind**	0,926	0,932	0,940	0,942	0,942
	Boot mean	0,926	0,933	0,940	0,938	0,941
	Boot min	0,917	0,927	0,935	0,942	0,939
	Boot max	0,934	0,938	0,944	0,946	0,944
SBI first 2 digits	**Rind**	0,901	0,939	0,965	0,968	0,973
	Boot mean	0,899	0,937	0,962	0,960	0,970
	Boot min	0,890	0,930	0,957	0,966	0,966
	Boot max	0,908	0,943	0,967	0,972	0,975
SBI sub sections	**Rind**	0,909	0,943	0,969	0,974	0,978
	Boot mean	0,908	0,942	0,967	0,968	0,977
	Boot min	0,899	0,936	0,962	0,972	0,973
	Boot max	0,916	0,948	0,972	0,976	0,980
opgave periode	**Rind**	0,881	0,943	0,947	0,958	0,984
	Boot mean	0,880	0,942	0,946	0,952	0,983
	Boot min	0,872	0,935	0,940	0,957	0,978
	Boot max	0,889	0,949	0,953	0,962	0,988
VAT 3 groups	**Rind**	0,951	0,958	0,965	0,963	0,962
	Boot mean	0,951	0,958	0,965	0,963	0,962
	Boot min	0,944	0,952	0,959	0,957	0,957
	Boot max	0,958	0,964	0,971	0,969	0,967
VAT 5 groups	**Rind**	0,937	0,947	0,955	0,955	0,955
	Boot mean	0,936	0,947	0,954	0,949	0,955
	Boot min	0,927	0,940	0,949	0,955	0,950
	Boot max	0,944	0,954	0,959	0,960	0,960
VAT 9 groups	**Rind**	0,935	0,944	0,952	0,953	0,953
	Boot mean	0,934	0,944	0,951	0,948	0,952
	Boot min	0,927	0,937	0,946	0,952	0,948
	Boot max	0,942	0,950	0,957	0,957	0,956

APPENDIX E.2

R-indicators of one auxiliary variable models for retail businesses

model		15d	30d	45d	60d	tot
respons percentage		0,50	0,78	0,86	0,88	0,92
mode of data collection	**Rind**	0,664	0,683	0,862	0,900	0,922
	Boot mean	0,666	0,683	0,861	0,900	0,922
	Boot Min	0,646	0,667	0,846	0,888	0,909
	Boot Max	0,687	0,699	0,876	0,912	0,935
GK	**Rind**	0,940	0,817	0,794	0,800	0,773
	Boot mean	0,937	0,815	0,793	0,800	0,772
	Boot Min	0,921	0,794	0,775	0,784	0,759
	Boot Max	0,953	0,837	0,811	0,817	0,785
SBI first 3 digits	**Rind**	0,876	0,908	0,899	0,900	0,903
	Boot mean	0,873	0,903	0,897	0,897	0,902
	Boot Min	0,849	0,885	0,880	0,881	0,887
	Boot Max	0,897	0,921	0,915	0,913	0,917
SBI first 4 digits	**Rind**	0,791	0,809	0,837	0,844	0,863
	Boot mean	0,779	0,801	0,829	0,839	0,859
	Boot Min	0,755	0,775	0,813	0,825	0,848
	Boot Max	0,803	0,827	0,846	0,853	0,871
SBI no seperation	**Rind**	0,685	0,726	0,764	0,779	0,811
	Boot mean	0,665	0,711	0,751	0,768	0,802
	Boot Min	0,640	0,685	0,735	0,754	0,791
	Boot Max	0,689	0,738	0,768	0,782	0,814
period	**Rind**	0,632	0,830	0,899	0,922	0,939
	Boot mean	0,631	0,828	0,897	0,919	0,935
	Boot Min	0,608	0,809	0,882	0,906	0,923
	Boot Max	0,654	0,846	0,912	0,931	0,948
VAT 9 groups	**Rind**	0,724	0,753	0,756	0,769	0,790
	Boot mean	0,723	0,751	0,756	0,767	0,790
	Boot Min	0,698	0,733	0,740	0,752	0,778
	Boot Max	0,747	0,769	0,772	0,782	0,802
VAT 17 groups	**Rind**	0,718	0,747	0,752	0,763	0,782
	Boot mean	0,716	0,745	0,751	0,761	0,780
	Boot Min	0,696	0,728	0,736	0,747	0,768
	Boot Max	0,736	0,761	0,765	0,776	0,792
VAT 33 groups	**Rind**	0,708	0,743	0,749	0,760	0,780
	Boot mean	0,701	0,739	0,745	0,757	0,778
	Boot Min	0,679	0,722	0,730	0,741	0,766
	Boot Max	0,724	0,757	0,760	0,773	0,791

Appendix E.3

Industry models

model		15d	30d	45d	60d	tot
respons percentage		0,49	0,79	0,86	0,88	0,92
GK	**Rind**	0,926	0,932	0,940	0,942	0,942
	Boot mean	0,926	0,933	0,940	0,938	0,941
	Boot min	0,917	0,927	0,935	0,942	0,939
	Boot max	0,934	0,938	0,944	0,946	0,944
SBI sub sections	**Rind**	0,909	0,943	0,969	0,974	0,978
	Boot mean	0,908	0,942	0,967	0,968	0,977
	Boot min	0,899	0,936	0,962	0,972	0,973
	Boot max	0,916	0,948	0,972	0,976	0,980
VAT 9 groups	**Rind**	0,935	0,944	0,952	0,953	0,953
	Boot mean	0,934	0,944	0,951	0,948	0,952
	Boot min	0,927	0,937	0,946	0,952	0,948
	Boot max	0,942	0,950	0,957	0,957	0,956
GK x VAT9	**Rind**	0,909	0,919	0,930	0,933	0,935
	Boot mean	0,907	0,917	0,929	0,932	0,935
	Boot Min	0,899	0,911	0,924	0,928	0,931
	Boot Max	0,914	0,922	0,934	0,936	0,938
GK x SBI sub Sections	**Rind**	0,871	0,903	0,926	0,933	0,937
	Boot mean	0,867	0,901	0,924	0,931	0,935
	Boot Min	0,860	0,895	0,919	0,927	0,932
	Boot Max	0,875	0,907	0,928	0,935	0,939
VAT x SBI sub Sections	**Rind**	0,873	0,908	0,932	0,936	0,940
	Boot mean	0,866	0,901	0,926	0,931	0,936
	Boot Min	0,858	0,895	0,920	0,925	0,931
	Boot Max	0,874	0,907	0,932	0,936	0,941
GK x VAT 9 x SBI sub Sections	**Rind**	0,841	0,877	0,904	0,912	0,917
	Boot mean	0,826	0,867	0,895	0,905	0,909
	Boot Min	0,835	0,873	0,900	0,909	0,914
	Boot Max	0,845	0,879	0,906	0,914	0,919

Appendix E.4

Retail models

model		15d	30d	45d	60d	tot
respons percentage		0,50	0,78	0,86	0,88	0,92
VAT 9 groups	Rind	0,724	0,753	0,756	0,769	0,790
	Boot mean	0,723	0,751	0,756	0,767	0,790
	Boot Min	0,698	0,733	0,740	0,752	0,778
	Boot Max	0,747	0,769	0,772	0,782	0,802
GK	Rind	0,940	0,817	0,794	0,800	0,773
	Boot mean	0,937	0,815	0,793	0,800	0,772
	Boot Min	0,921	0,794	0,775	0,784	0,759
	Boot Max	0,953	0,837	0,811	0,817	0,785
SBI first 3 digits	Rind	0,876	0,908	0,899	0,900	0,903
	Boot mean	0,873	0,903	0,897	0,897	0,902
	Boot Min	0,849	0,885	0,880	0,881	0,887
	Boot Max	0,897	0,921	0,915	0,913	0,917
GK x VAT 9 groups	Rind	0,631	0,610	0,616	0,640	0,661
	Boot mean	0,626	0,608	0,613	0,637	0,660
	Boot Min	0,602	0,581	0,592	0,618	0,642
	Boot Max	0,650	0,635	0,634	0,656	0,678
GK x SBI first 3 digits	Rind	0,821	0,722	0,716	0,721	0,731
	Boot mean	0,811	0,717	0,712	0,719	0,730
	Boot Min	0,790	0,700	0,697	0,705	0,719
	Boot Max	0,833	0,734	0,728	0,734	0,742
GK x SBI first 4 digits	Rind	0,670	0,674	0,689	0,703	0,708
	Boot mean	0,649	0,660	0,678	0,694	0,702
	Boot Min	0,622	0,639	0,659	0,677	0,687
	Boot Max	0,676	0,681	0,697	0,711	0,717
VAT 9 + SBI first 3 Digits	Rind	0,708	0,746	0,752	0,763	0,787
	Boot mean	0,704	0,742	0,749	0,761	0,787
	Boot Min	0,682	0,724	0,734	0,747	0,774
	Boot Max	0,726	0,760	0,764	0,775	0,799
GK x VAT 5 x SBI first 3 digits*	Rind	0,570	0,572	0,588	0,617	0,642
	Boot mean	0,557	0,563	0,581	0,613	0,638
	Boot Min	0,533	0,538	0,561	0,591	0,619
	Boot Max	0,581	0,588	0,600	0,634	0,658

* the model GK x Vat 9 groups x SBI first 3 digits could not be calculated using s-plus
VAT 5 groups was therefore used instead.

Appendix F

Figures of the R-indicators including response representativity functions for the logistic regression models. In these figures we can see the developments of the R-indicators over time for the different univariate and multivariate models. In these figures we use method of observation to refer to the mode of data collection. BTW 3 is equal to VAT with 3 groups. And SBI can differ in the number of digits. Period is the different months of the survey.

Appendix F.1 consists of one variable models for industrial businesses

In each of these figures we can see three descending lines. These represent the response representativity functions, where $\gamma = 0.01$, 0.05 and 0.1. The mathematical notation can be found in formula (9). The strictest boundary is $\gamma = 0.01$ and thus the top line in the graph. The loosest boundary is $\gamma = 0.1$. The remaining line in the different figures is the R-indicator for the different univariate models.

Appendix F.2 consists of one variable models for retail businesses

In each of these figures we can see three descending lines. These represent the response representativity functions, where $\gamma = 0.01$, 0.05, 0.1, 0.15 and 0.2. The mathematical notation can be found in formula (9). The strictest boundary is $\gamma = 0.01$ and thus the top line in the graph. The loosest boundary is $\gamma = 0.2$. The remaining line in the different figures is the R-indicator for the different univariate models.

Appendix F.3 consists of multivariate models for industrial businesses

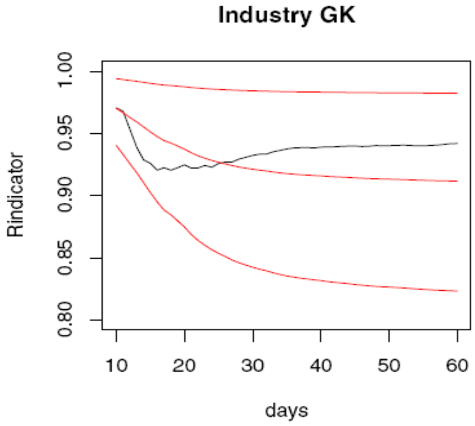
In each of these figures we can see three descending lines. These represent the response representativity functions, where $\gamma = 0.01$, 0.05 and 0.1. The mathematical notation can be found in formula (9). The strictest boundary is $\gamma = 0.01$ and thus the top line in the graph. The loosest boundary is $\gamma = 0.1$. The remaining lines are R-indicators for the different multivariate models.

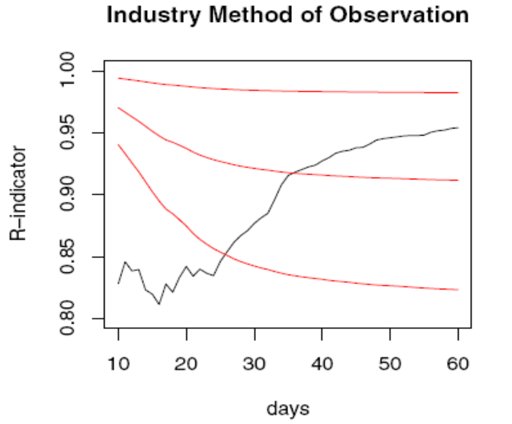
Appendix F.4 consists of multivariate models for retail businesses

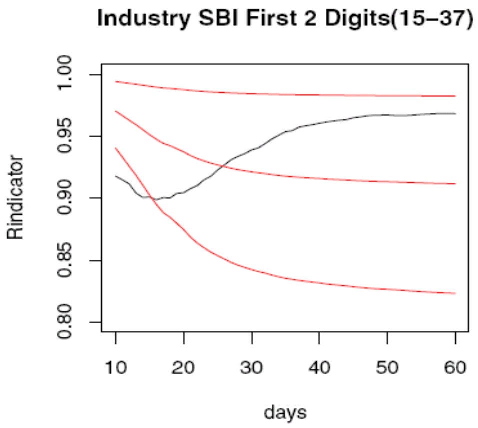
In each of these figures we can see three descending lines. These represent the response representativity functions, where $\gamma = 0.01$, 0.05, 0.1, 0.15 and 0.2. The mathematical notation can be found in formula (9). The strictest boundary is $\gamma = 0.01$ and thus the top line in the graph. The loosest boundary is $\gamma = 0.2$. The remaining line in the different figures is the R-indicator for the different multivariate models.

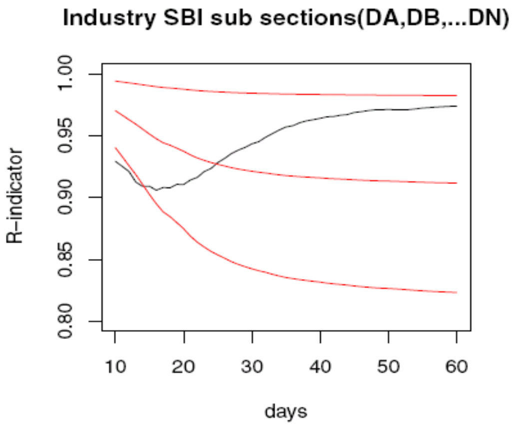
Appendix F.1

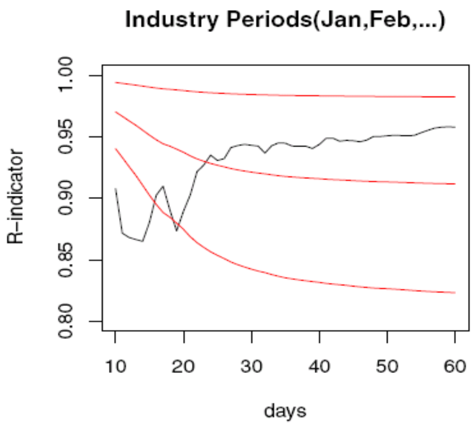
Figures of one auxiliary variable models for industrial businesses

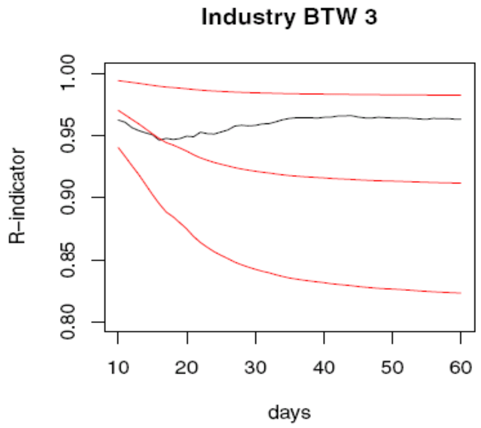


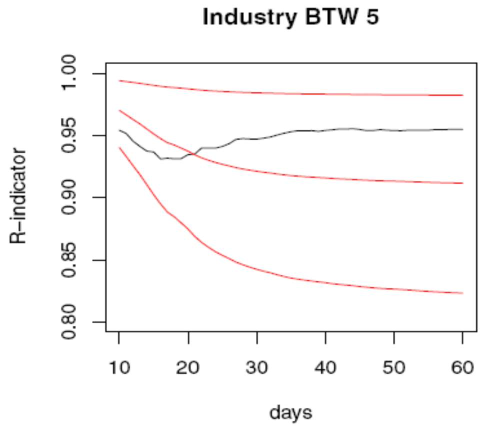









Industry BTW 3
R–indicator
0.80
0.85
0.90
0.95
1.00
10
20
30
40
50
60
days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R–indicator
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0.85
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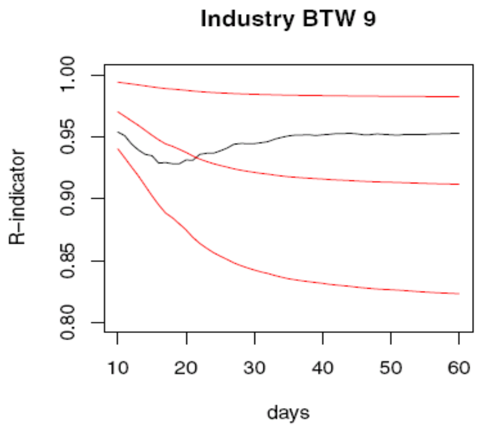
0.95
1.00
10
20
30
40
50
60
days


Industry BTW 9
R–indicator
0.80
0.85
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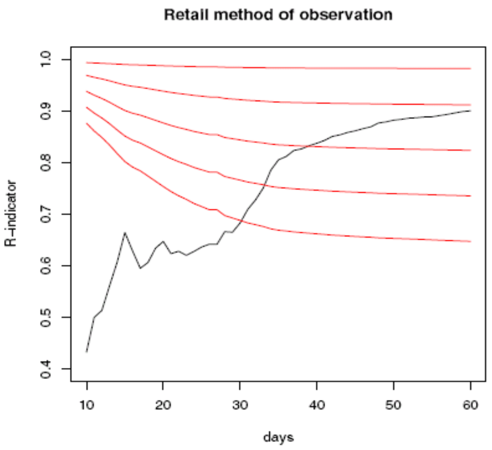
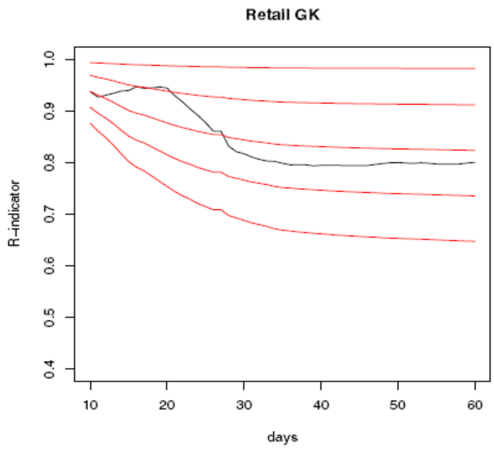
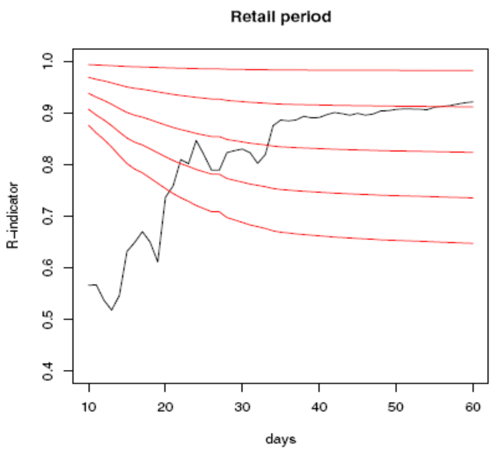
0.95
1.00
10
20
30
40
50
60
days

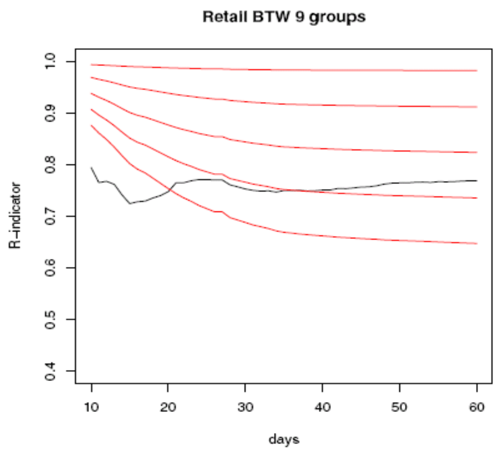
Appendix F.2

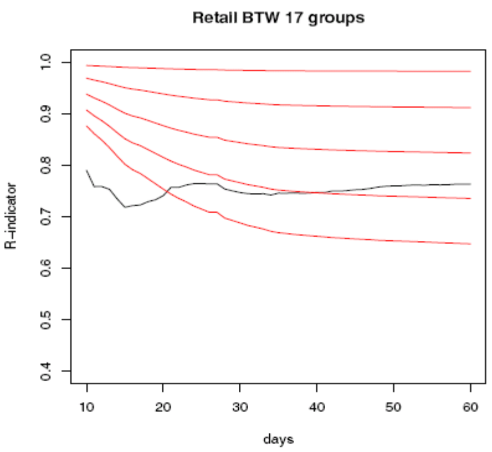
Figures of one auxiliary variable models for retail businesses

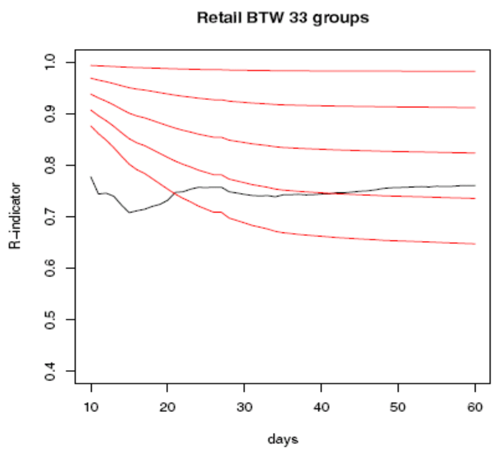


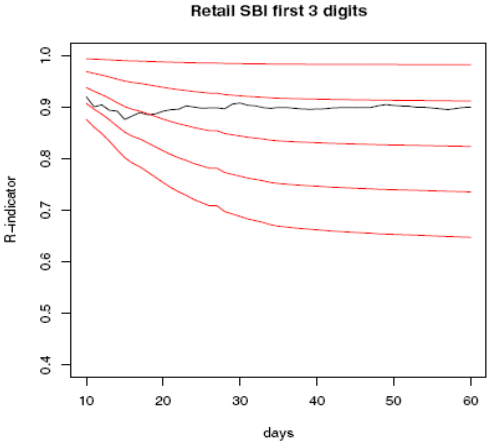


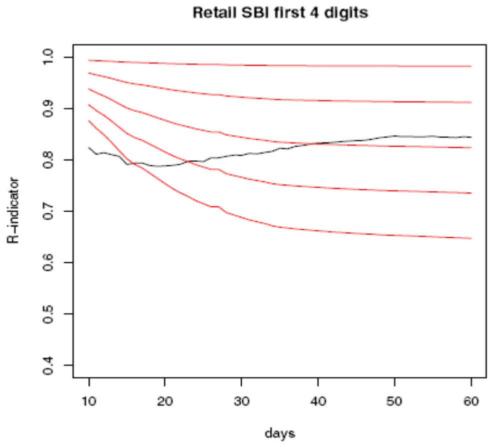


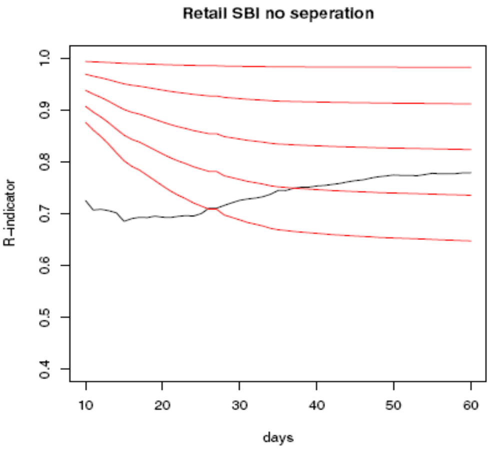






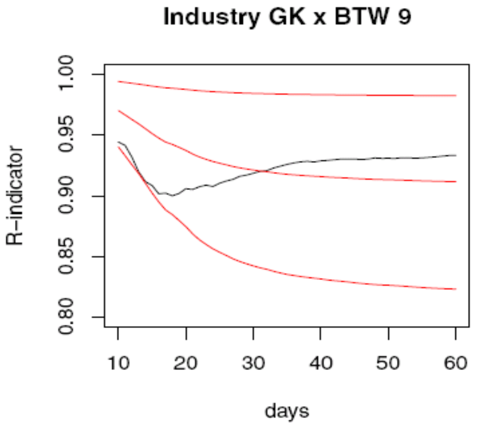

Retail SBI first 3 digits
R-indicator
days

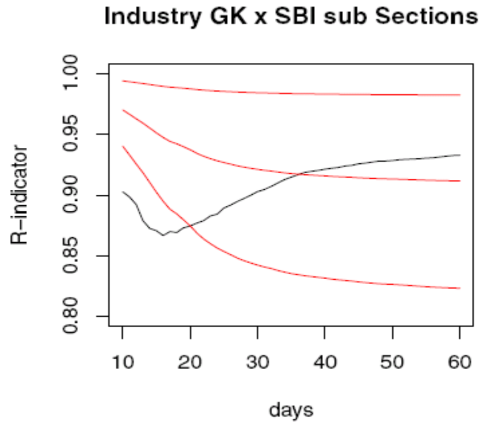

Retail SBI first 4 digits
R-indicator
days

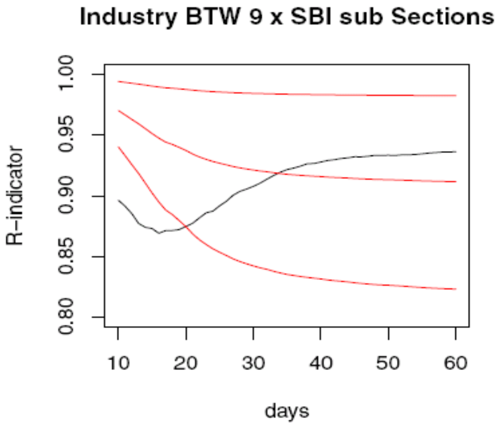

Retail SBI no seperation
R-indicator
days

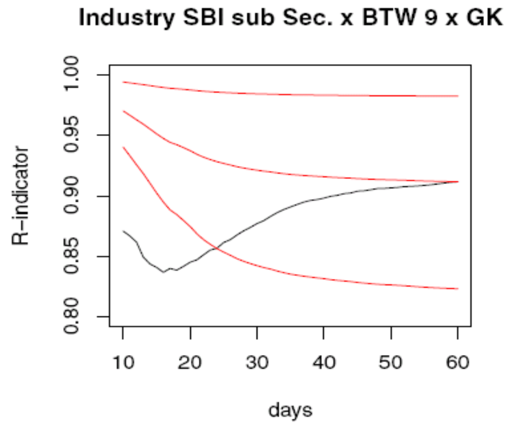
Appendix F.3

Figures of industrial bussinesses with multivariate models



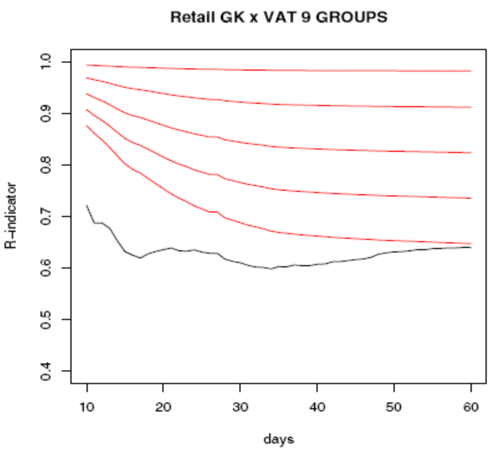


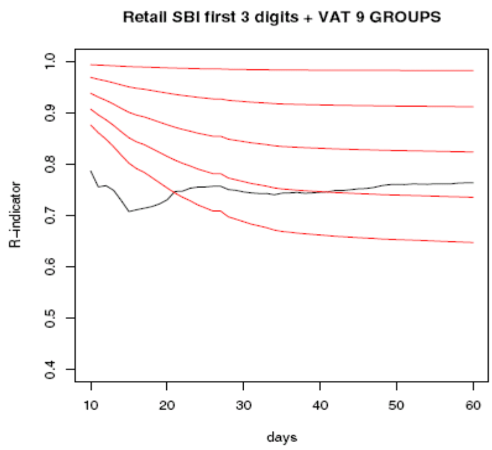


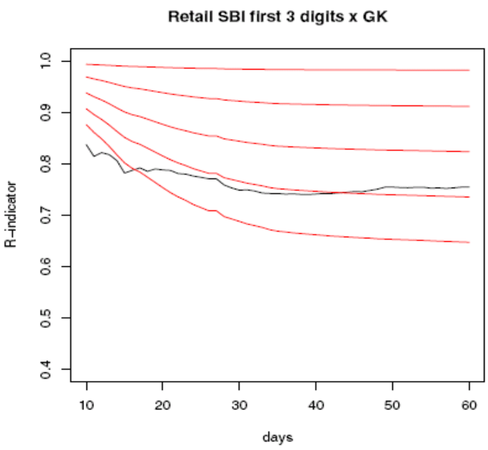


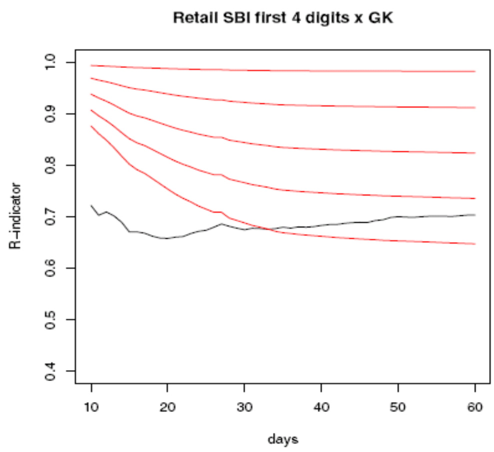
Appendix F.4

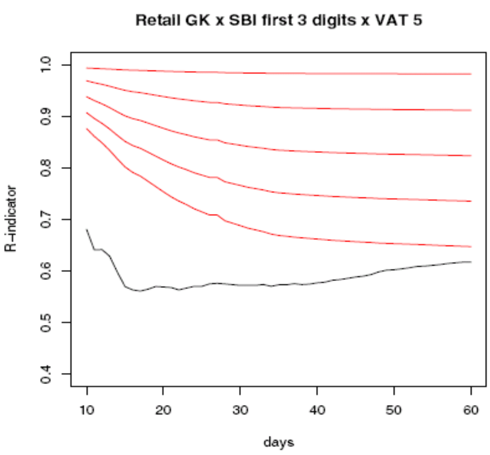
Figures of retail bussinesses with multivariate models











Appendix G

Tables industry: separated on mode of data collection

Electronic survey login codes sent through e-mail

model	15d	30d	45d	60d	tot
perc respons binnen	0,55	0,83	0,88	0,90	0,94
GK	0,928	0,941	0,941	0,941	0,937
period	0,887	0,940	0,941	0,947	0,979
VAT 9 groups	0,938	0,953	0,951	0,948	0,946
GK x VAT 9 Groups	0,914	0,929	0,932	0,932	0,930
SBI sub Sections reduced	0,889	0,931	0,955	0,965	0,973

Electronic survey log in codes sent via a letter

model	15d	30d	45d	60d	tot
perc respons binnen	0,46	0,77	0,84	0,87	0,90
GK	0,944	0,935	0,938	0,942	0,941
period	0,855	0,887	0,883	0,890	0,878
VAT 9 groups	0,944	0,965	0,966	0,969	0,960
SBI sub Sections reduced	0,898	0,916	0,931	0,933	0,936

Paper surveys

model	15d	30d	45d	60d	tot
perc respons binnen	0,33	0,68	0,80	0,85	0,91
As character GK	0,958	0,955	0,958	0,967	0,974
period	0,815	0,859	0,887	0,912	0,961
VAT 9 groups	0,963	0,953	0,963	0,967	0,970
GKxVAT 9 groups	0,938	0,932	0,937	0,944	0,947
SBI sub Sections reduced	0,936	0,942	0,962	0,958	0,962

Electronic surveys

model	15d	30d	45d	60d	tot
perc respons binnen	0,53	0,82	0,87	0,89	0,93
As character GK	0,934	0,939	0,940	0,940	0,936
OPGAVE PERIODE	0,889	0,963	0,963	0,972	0,983
BTW 9 groepen	0,948	0,955	0,953	0,951	0,947
GKxVAT	0,922	0,928	0,932	0,932	0,929
SBI sub Sections reduced	0,902	0,938	0,960	0,966	0,973

Tables retail: separated on mode of data collection

Electronic surveys log in codes sent throught e-mail

model	15d	30d	45d	60d	tot
percentage response	0,57	0,86	0,89	0,91	0,94
SBI 3 digits	0,744	0,902	0,922	0,928	0,932
VAT 9 groups	0,709	0,904	0,870	0,851	0,800
SBI first 4 digits	0,639	0,805	0,846	0,867	0,892
PERIOD	0,717	0,880	0,882	0,891	0,936
GK	0,645	0,927	0,889	0,863	0,781

Electronic surveys log in codes sent via a letter

model	15d	30d	45d	60d	tot
percentage response	0,53	0,81	0,87	0,89	0,93
SBI 3 digits	0,854	0,934	0,933	0,929	0,923
VAT 9 groups	0,855	0,816	0,826	0,828	0,844
SBI first 4 digits	0,658	0,773	0,792	0,813	0,828
PERIOD	0,735	0,802	0,812	0,825	0,863
GK	0,921	0,784	0,782	0,782	0,798

Paper surveys

model	15d	30d	45d	60d	tot
percentage response	0,45	0,74	0,84	0,87	0,91
GK x VAT 9 groups	0,517	0,511	0,490	0,518	0,565
SBI first 3 digits	0,764	0,807	0,816	0,835	0,864
SBI	0,504	0,551	0,640	0,669	0,722
VAT 9 groups	0,592	0,618	0,614	0,630	0,682
SBI first 4 digits	0,634	0,648	0,721	0,741	0,786
PERIOD	0,462	0,712	0,875	0,911	0,921
GK	0,913	0,866	0,794	0,802	0,771

Electronic surveys

model	15d	30d	45d	60d	tot
percentage response	0,55	0,83	0,88	0,90	0,94
GK x VAT 9 groups	0,739	0,769	0,783	0,782	0,766
SBI first 3 digits	0,848	0,933	0,940	0,939	0,930
SBI	0,602	0,729	0,756	0,776	0,803
VAT 9 groups	0,828	0,868	0,873	0,868	0,846
SBI first 4 digits	0,741	0,837	0,855	0,876	0,882
PERIOD	0,739	0,895	0,915	0,922	0,950
GK	0,849	0,836	0,827	0,819	0,790

Appendix H

R-indicators for industry with unlinked VAT removed

	15d	30d	45d	60d	tot
percentage respons	0,49	0,79	0,86	0,88	0,92
GK	0,923	0,938	0,945	0,946	0,945
SBI first 2 Digits	0,905	0,937	0,961	0,965	0,966
SBI sub Sections	0,913	0,942	0,966	0,971	0,972
Period	0,874	0,950	0,952	0,963	0,982
VAT 9 groups	0,924	0,931	0,947	0,948	0,952
method of observation	0,825	0,881	0,940	0,956	0,966
GKxVAT	0,900	0,913	0,930	0,938	0,938

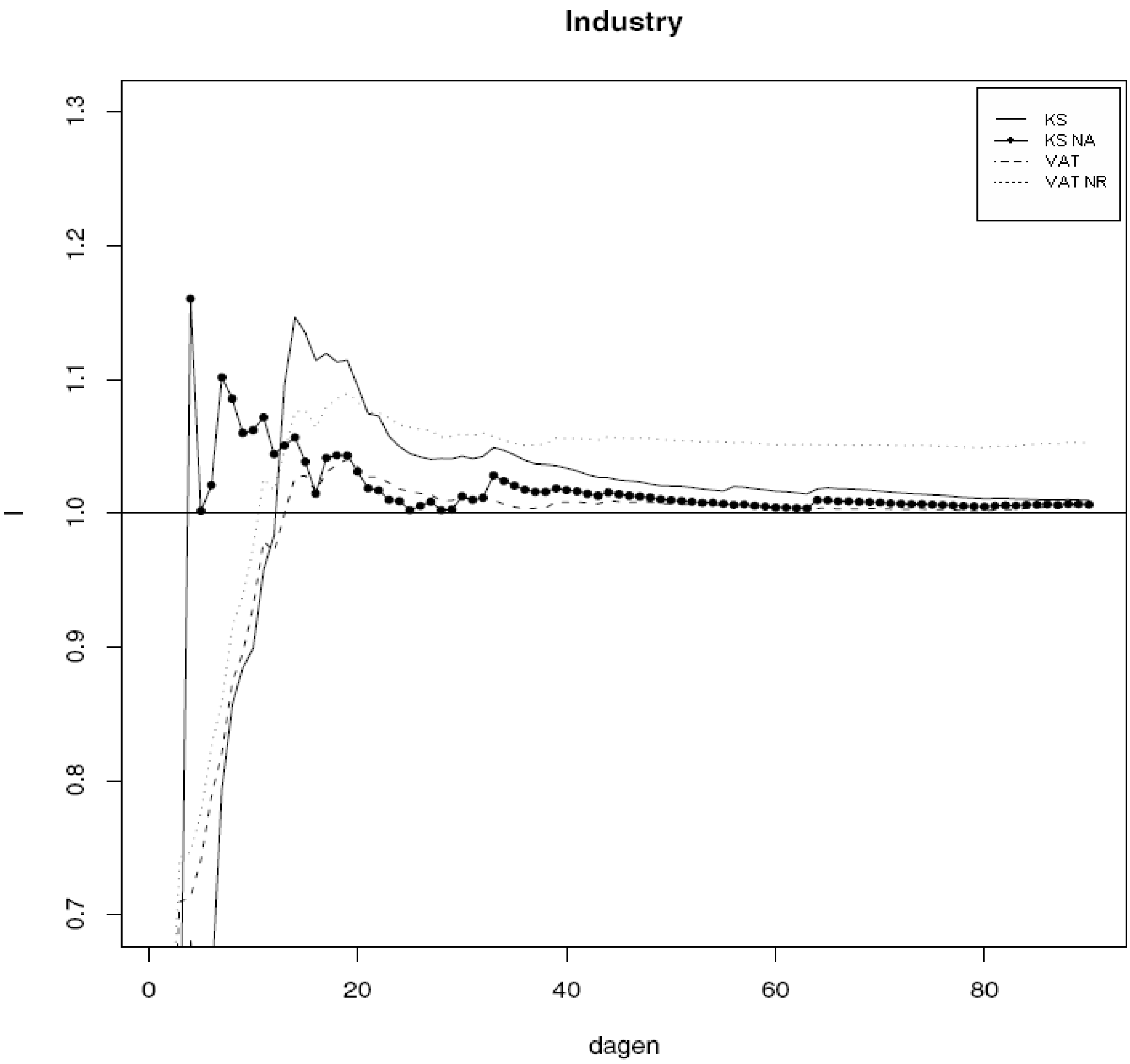
R-indicators for retail with unlinked VAT removed

	15	30	45	60	tot
percentage response	0,50	0,79	0,87	0,89	0,93
GK x VAT 9 groups	0,646	0,657	0,671	0,700	0,717
SBI first 3 digits	0,861	0,929	0,929	0,927	0,932
SBI	0,669	0,736	0,787	0,806	0,833
VAT 9 groups	0,714	0,751	0,765	0,785	0,803
SBI first 4 digits	0,777	0,812	0,855	0,864	0,882
PERIOD	0,619	0,829	0,899	0,923	0,934
GK	0,921	0,847	0,824	0,832	0,803

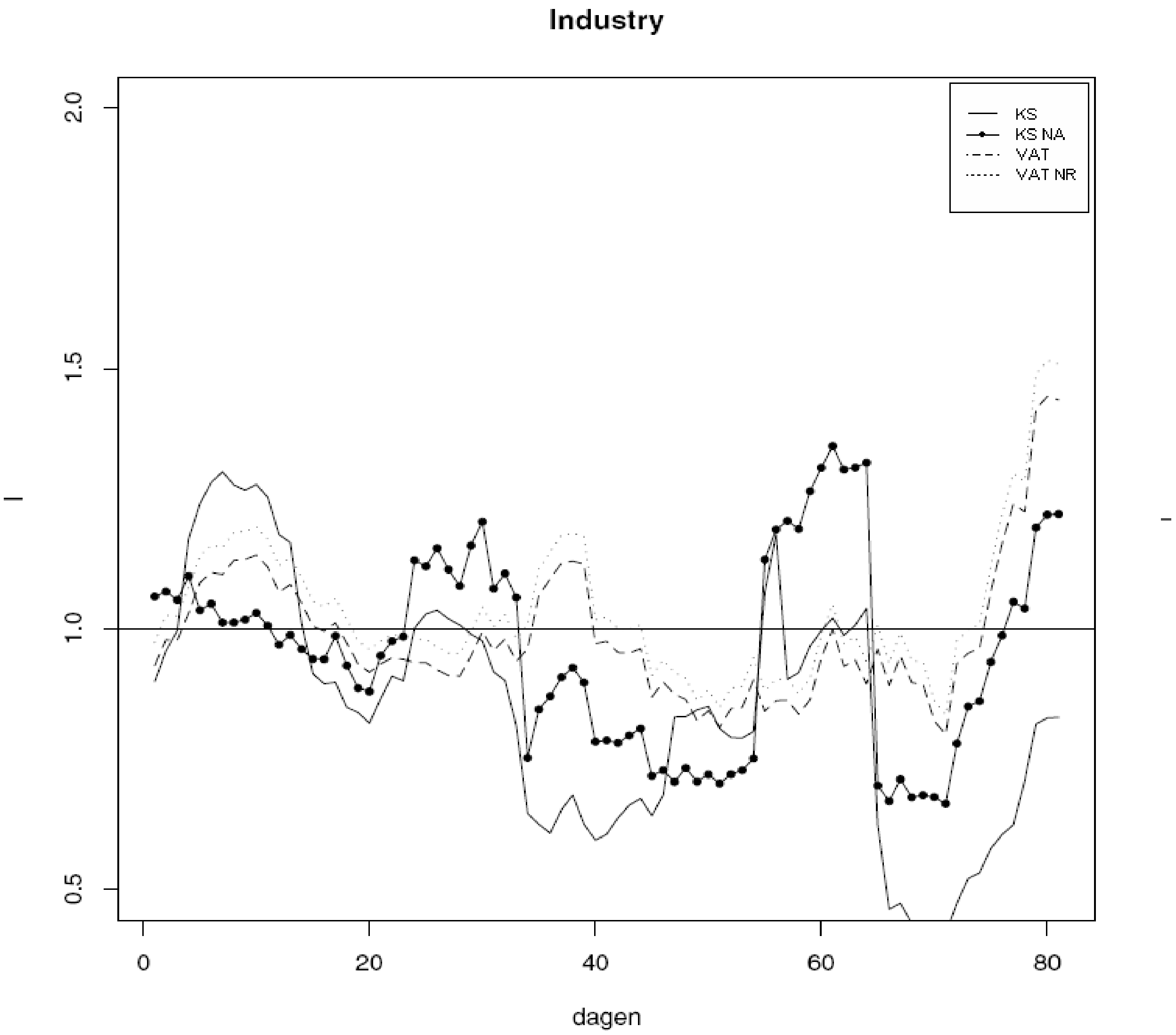
Appendix I

Revenue figures from chapter 4 additionally with moving averages with a 5 day window

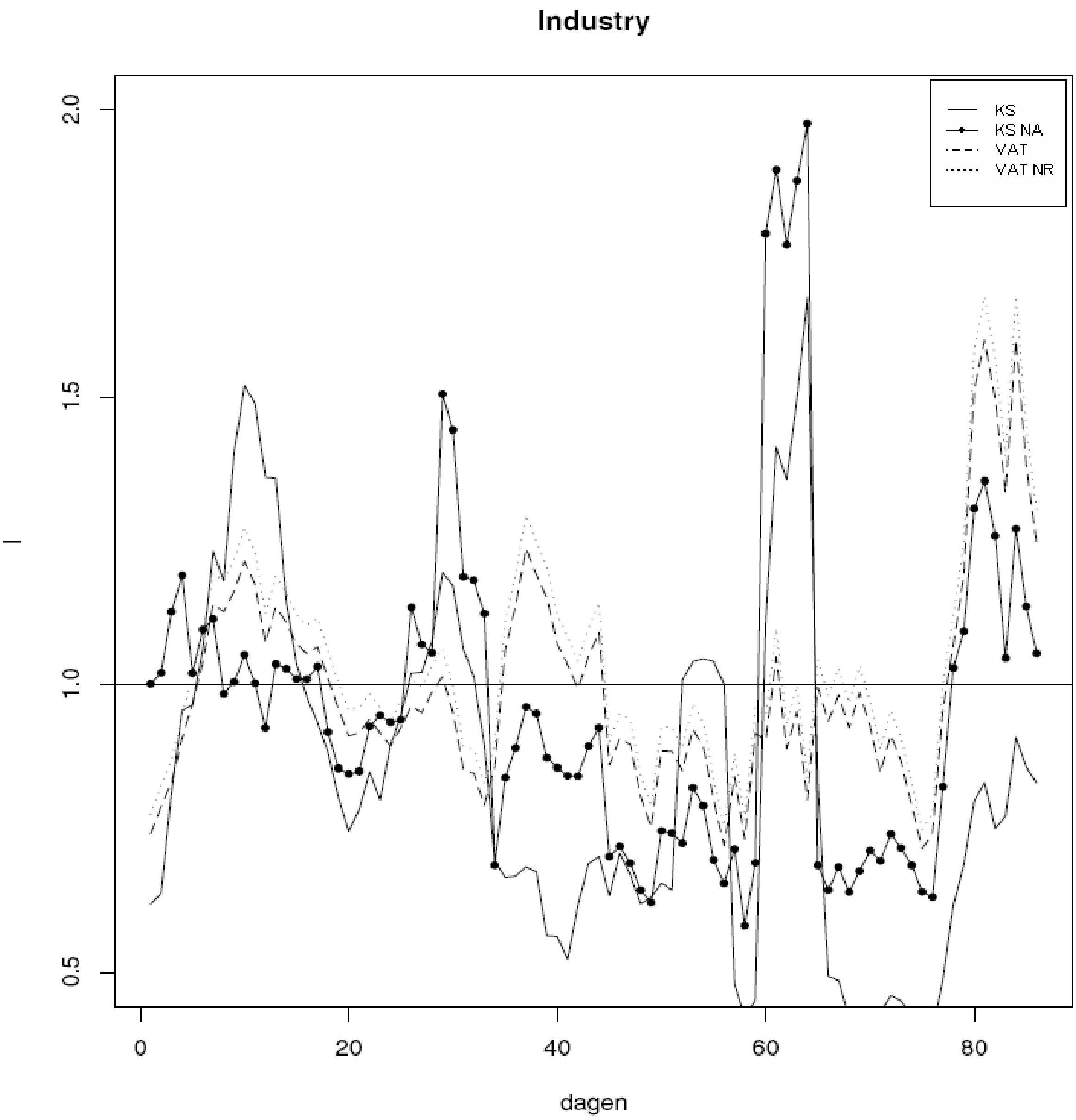
Identical to figure 4.1



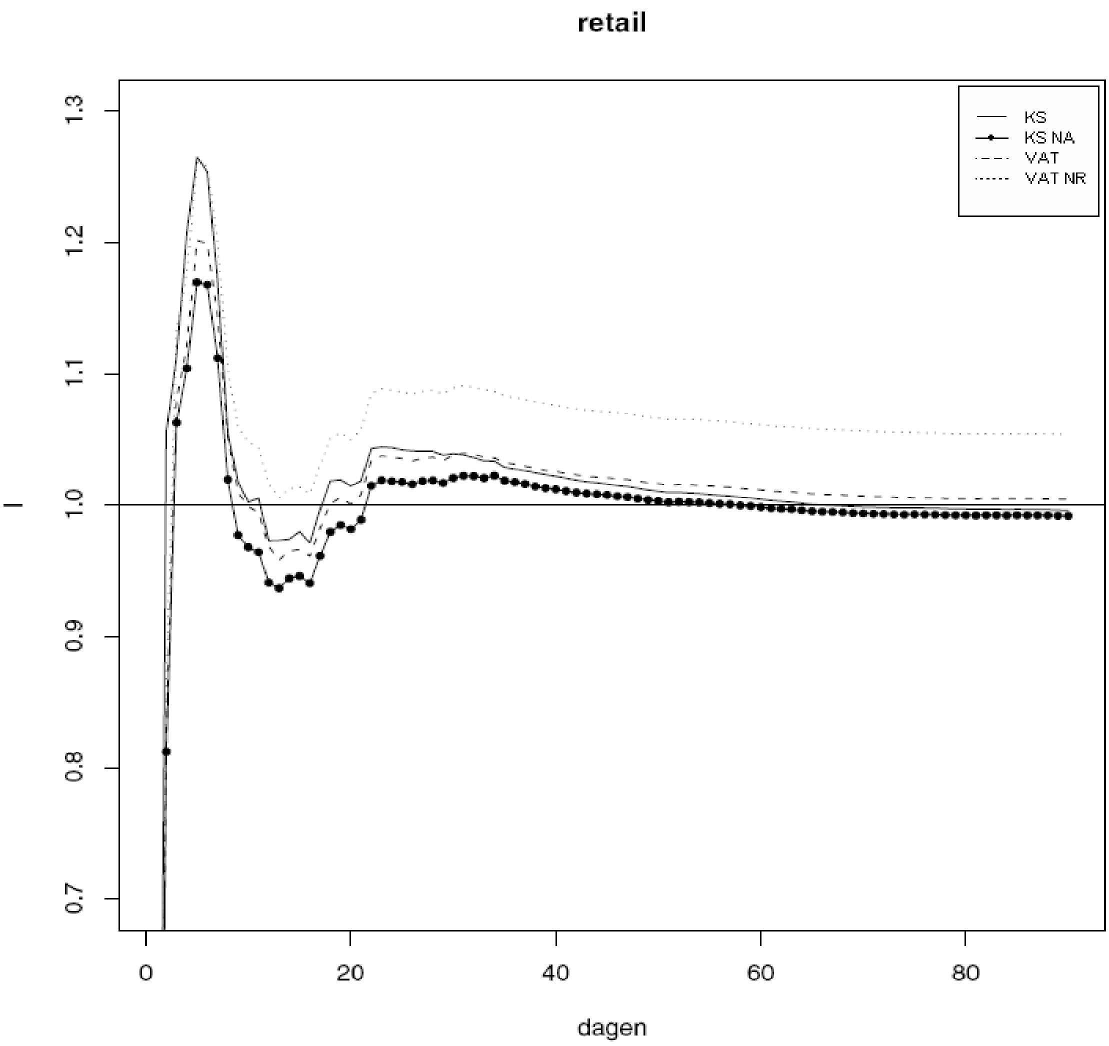
Identical to Figure 4.2



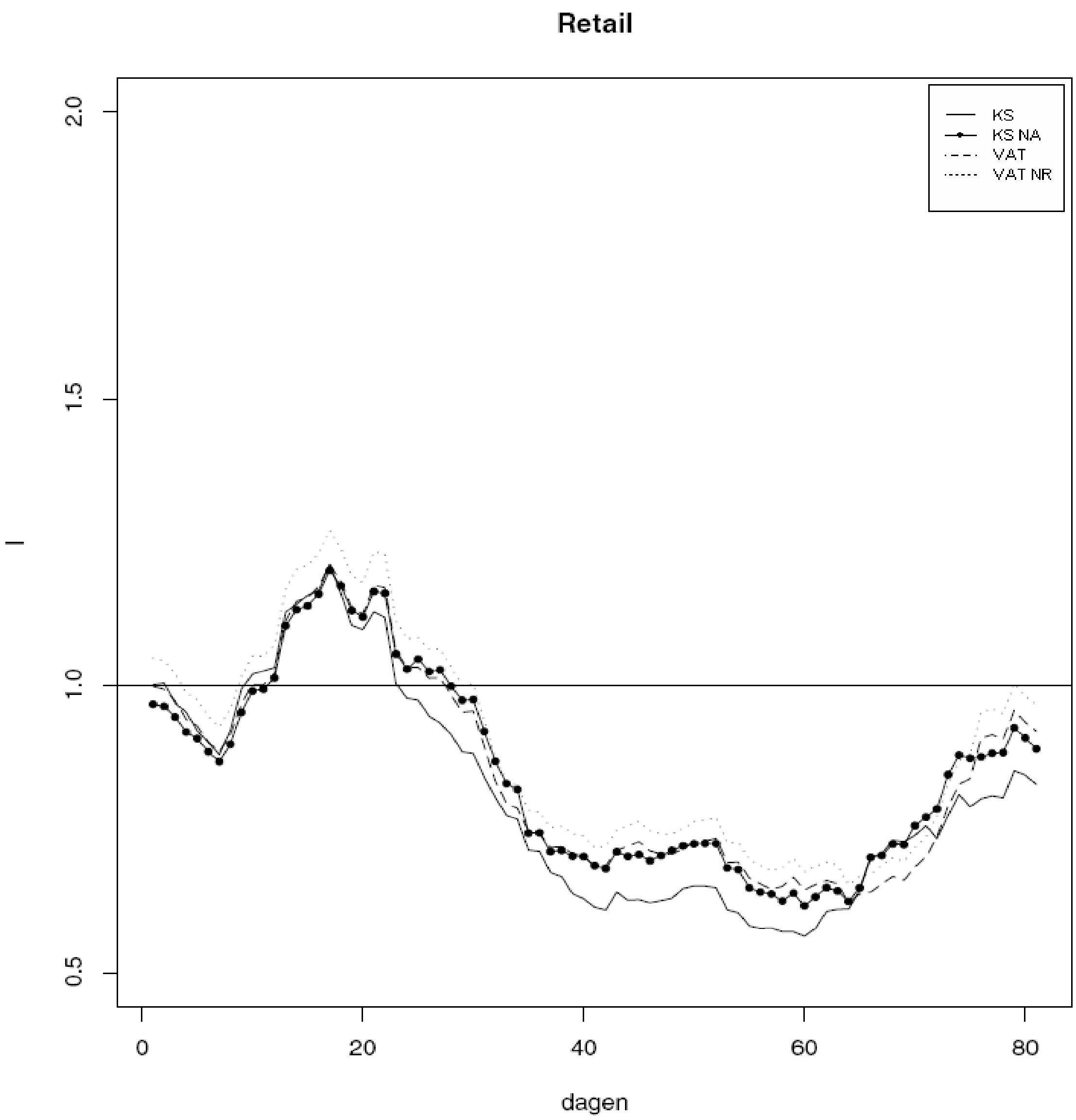
Moving averages with a 5 day window.



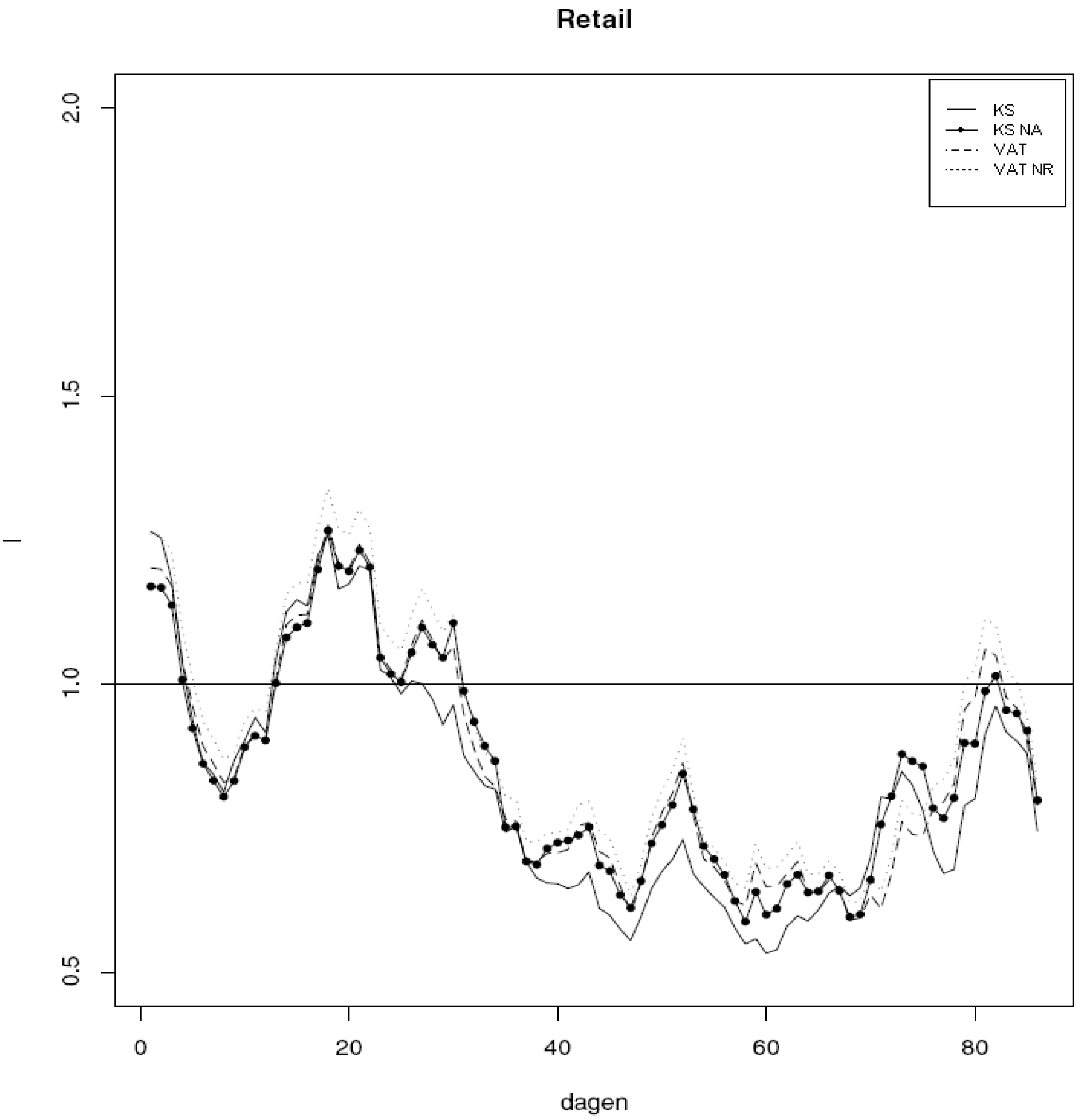
Identical to figure 4.3



Identical to figure 4.4



Moving Average with a 5 day window



Appendix J

Table of estimates for industry and retail for the logistic regression model SBI.
For industry SBI was devided in 2 digits and for retail in 4 digits

Industry	15d	30d	45d	60d	tot
	Estimate(std. Error)	Estimate(std. Error)	Estimate(std. Error)	Estimate(std. Error)	Estimate(std. Error)
(Intercept)	-0,030 (0,024)	1,400 (0,030) ***	1,869 (0,035) ***	2,108 (0,038) ***	2,534 (0,046) ***
16	0,268 (0,187)	0,382 (0,264)	0,309 (0,304)	0,509 (0,354)	0,814 (0,497)
17	0,191 (0,059) **	-0,193 (0,071) **	-0,289 (0,080) ***	-0,364 (0,085) ***	-0,398 (0,099) ***
18	-0,181 (0,128)	-0,189 (0,151)	0,046 (0,189)	-0,084 (0,197)	-0,350 (0,212) ,
19	0,356 (0,159) *	0,079 (0,201)	-0,035 (0,227)	0,069 (0,257)	0,941 (0,440) *
20	0,187 (0,049) ***	0,084 (0,062)	0,001 (0,071)	-0,026 (0,077)	0,040 (0,094)
21	0,154 (0,055) **	-0,003 (0,068)	-0,174 (0,076) *	-0,130 (0,084)	-0,054 (0,102)
22	-0,069 (0,036) ,	-0,096 (0,045) *	-0,146 (0,052) **	-0,168 (0,056) **	-0,071 (0,068)
23	0,605 (0,172) ***	-0,095 (0,201)	-0,211 (0,225)	-0,293 (0,238)	-0,477 (0,262) ,
24	0,415 (0,041) ***	0,448 (0,056) ***	0,397 (0,066) ***	0,401 (0,072) ***	0,428 (0,088) ***
25	0,113 (0,041) **	-0,040 (0,051)	-0,046 (0,060)	-0,104 (0,065)	-0,062 (0,078)
26	0,157 (0,048) **	0,073 (0,061)	0,008 (0,071)	-0,023 (0,076)	0,235 (0,099) *
27	0,152 (0,076) *	0,162 (0,100)	0,099 (0,115)	0,144 (0,127)	0,314 (0,164) ,
28	-0,126 (0,030) ***	-0,168 (0,037) ***	-0,115 (0,044) **	-0,132 (0,047) **	-0,101 (0,057) ,
29	-0,225 (0,031) ***	-0,291 (0,038) ***	-0,196 (0,045) ***	-0,185 (0,049) ***	-0,082 (0,059)
30	0,007 (0,152)	-0,542 (0,166) **	-0,663 (0,181) ***	-0,902 (0,182) ***	-1,017 (0,200) ***
31	0,112 (0,057) *	-0,076 (0,071)	-0,128 (0,081)	-0,147 (0,088) ,	-0,181 (0,103) ,
32	-0,120 (0,078)	-0,113 (0,094)	-0,225 (0,106) *	-0,294 (0,113) **	-0,418 (0,128) **
33	0,160 (0,050) **	0,097 (0,064)	0,081 (0,074)	0,078 (0,081)	0,089 (0,097)
34	-0,242 (0,058) ***	-0,369 (0,066) ***	-0,211 (0,079) **	-0,106 (0,088)	0,307 (0,122) *
35	-0,472 (0,057) ***	-0,293 (0,065) ***	-0,193 (0,077) *	-0,132 (0,086)	0,122 (0,111)
36	0,091 (0,046) *	-0,031 (0,057)	-0,082 (0,066)	-0,122 (0,071) ,	-0,228 (0,082) **
37	-0,399 (0,098) ***	-0,413 (0,108) ***	-0,174 (0,133)	-0,081 (0,149)	-0,089 (0,177)
Signif,	codes:	'***' 0,001	'*' 0,05		
		'**' 0,01	',' 0,1		

Retail	15d	30d	45d	60d	tot
	Estimate(std. Err.)	Estimate(std. Err.)	Estimate(std. Err.)	Estimate(std. Err.)	Estimate(std. Err.)
5211	-0,013 (0,010)	1,340 (0,013) ***	1,939 (0,017) ***	2,179 (0,018) ***	2,742 (0,026) ***
5221	-0,151 (0,064) *	-0,153 (0,075) *	-0,213 (0,082) **	-0,310 (0,087) ***	-0,332 (0,100) ***
5223	-0,100 (0,051) *	-0,231 (0,054) ***	-0,300 (0,056) ***	-0,358 (0,058) ***	-0,459 (0,061) ***
5225	0,114 (0,023) ***	0,171 (0,028) ***	0,248 (0,034) ***	0,245 (0,036) ***	0,268 (0,042) ***
5226	0,014 (0,014)	0,050 (0,017) **	0,088 (0,020) ***	0,081 (0,021) ***	0,108 (0,025) ***
5233	-0,015 (0,028)	-0,022 (0,032)	0,059 (0,043)	0,104 (0,051) *	0,356 (0,111) **
5261	-0,017 (0,013)	-0,007 (0,016)	0,017 (0,019)	0,008 (0,021)	-0,032 (0,027)
5271	0,028 (0,012) *	0,012 (0,014)	0,025 (0,018)	0,021 (0,019)	0,033 (0,026)
5272	0,005 (0,014)	0,045 (0,019) *	0,093 (0,027) ***	0,114 (0,031) ***	0,108 (0,041) **
5273	0,012 (0,006) *	0,009 (0,007)	-0,006 (0,009)	-0,007 (0,009)	-0,023 (0,013) ,
5274	0,023 (0,006) ***	0,014 (0,007) ,	0,007 (0,009)	0,012 (0,010)	0,028 (0,014) ,
52121	0,021 (0,010) *	0,041 (0,014) **	0,071 (0,020) ***	0,072 (0,022) ***	0,053 (0,026) *
52122	0,005 (0,009)	0,003 (0,011)	-0,013 (0,013)	-0,016 (0,014)	-0,025 (0,017)
52221	-0,038 (0,010) ***	-0,066 (0,010) ***	-0,060 (0,011) ***	-0,057 (0,012) ***	-0,054 (0,015) ***
52222	0,002 (0,007)	0,002 (0,009)	-0,013 (0,010)	-0,017 (0,011)	-0,028 (0,013) *
52241	0,002 (0,004)	-0,009 (0,005) ,	-0,010 (0,006) ,	-0,014 (0,006) *	0,004 (0,008)
52242	0,007 (0,006)	0,014 (0,008) ,	0,000 (0,009)	-0,001 (0,010)	0,004 (0,013)
52271	0,005 (0,005)	0,000 (0,006)	-0,002 (0,008)	-0,002 (0,008)	0,012 (0,012)
52272	-0,010 (0,008)	0,033 (0,012) **	0,047 (0,016) **	0,046 (0,018) **	0,061 (0,026) *
52273	-0,008 (0,008)	0,021 (0,012) ,	0,040 (0,017) *	0,042 (0,019) *	0,042 (0,025) ,

Retail	15d	30d	45d	60d	tot
continued	**Estimate(std. Err.)**	**Estimate(std. Err.)**	**Estimate(std. Err.)**	**Estimate(std. Err.)**	**Estimate(std. Err.)**
52274	-0,004 (0,008)	-0,019 (0,009) *	-0,026 (0,010) *	-0,025 (0,011) *	-0,021 (0,014)
52321	0,012 (0,003) ***	0,010 (0,004) **	0,007 (0,005)	0,003 (0,005)	-0,009 (0,006)
52322	-0,002 (0,002)	-0,004 (0,002)	-0,008 (0,003) *	-0,008 (0,003) *	-0,013 (0,004) **
52411	-0,005 (0,003) ,	-0,009 (0,003) **	-0,016 (0,004) ***	-0,020 (0,004) ***	-0,031 (0,005) ***
52412	0,000 (0,002)	0,002 (0,002)	0,004 (0,003) ,	0,006 (0,003) *	0,002 (0,004)
52413	-0,009 (0,004) *	0,009 (0,005) ,	0,021 (0,007) **	0,019 (0,007) **	0,023 (0,010) *
52421	0,022 (0,005) ***	0,011 (0,006) ,	0,009 (0,008)	0,004 (0,008)	-0,014 (0,008) ,
52422	0,007 (0,003) *	-0,006 (0,004)	-0,015 (0,004) ***	-0,013 (0,005) **	-0,013 (0,006) *
52423	0,006 (0,002) **	0,011 (0,003) ***	0,007 (0,003) *	0,006 (0,003)	0,002 (0,004)
52424	-0,012 (0,003) ***	0,004 (0,004)	0,008 (0,005) ,	0,013 (0,005) *	0,013 (0,007) ,
52425	-0,008 (0,001) ***	-0,005 (0,001) ***	-0,005 (0,002) **	-0,004 (0,002) *	-0,005 (0,002) *
52426	-0,006 (0,002) **	-0,005 (0,002) *	0,001 (0,003)	0,001 (0,003)	0,005 (0,005)
52427	-0,008 (0,003) **	-0,009 (0,003) **	-0,005 (0,004)	-0,003 (0,004)	0,011 (0,007)
52431	-0,005 (0,001) ***	0,000 (0,002)	0,001 (0,002)	0,001 (0,002)	0,002 (0,003)
52432	-0,009 (0,003) **	-0,007 (0,004) *	-0,011 (0,004) **	-0,012 (0,004) **	-0,010 (0,005) ,
52441	-0,011 (0,005) *	-0,015 (0,005) **	-0,009 (0,007)	-0,008 (0,007)	-0,007 (0,009)
52442	-0,002 (0,002)	0,000 (0,003)	-0,002 (0,003)	-0,004 (0,003)	-0,007 (0,004) ,
52443	-0,002 (0,003)	0,001 (0,003)	-0,002 (0,004)	-0,003 (0,004)	-0,002 (0,005)
52444	0,002 (0,002)	-0,002 (0,002)	-0,005 (0,002) *	-0,005 (0,003) *	-0,007 (0,003) *
52445	0,004 (0,002) ,	0,003 (0,003)	0,003 (0,003)	0,002 (0,004)	-0,002 (0,004)
52446	-0,016 (0,001) ***	-0,021 (0,001) ***	-0,025 (0,002) ***	-0,025 (0,002) ***	-0,024 (0,002) ***
52447	0,004 (0,003)	0,001 (0,004)	0,012 (0,006) *	0,014 (0,006) *	0,033 (0,012) **
52451	0,004 (0,001) **	-0,004 (0,002) *	-0,002 (0,002)	-0,004 (0,002) ,	-0,005 (0,003) ,
52452	-0,005 (0,002) *	-0,003 (0,002)	-0,001 (0,003)	-0,004 (0,003)	-0,007 (0,004) *
52453	0,001 (0,004)	0,004 (0,005)	0,007 (0,006)	0,010 (0,007)	0,003 (0,008)
52454	-0,003 (0,002) ,	0,006 (0,002) **	0,006 (0,003) *	0,007 (0,003) *	0,003 (0,003)
52455	0,004 (0,002) *	0,003 (0,002)	0,004 (0,003)	0,005 (0,003)	0,006 (0,004)
52456	-0,005 (0,003) ,	0,002 (0,004)	0,000 (0,004)	0,001 (0,005)	0,002 (0,006)
52457	0,001 (0,002)	0,001 (0,003)	0,000 (0,003)	-0,002 (0,003)	-0,006 (0,004)
52458	-0,003 (0,001) ***	-0,001 (0,001)	0,000 (0,001)	0,000 (0,001)	-0,001 (0,002)
52461	-0,010 (0,001) ***	-0,008 (0,002) ***	-0,008 (0,002) ***	-0,009 (0,002) ***	-0,012 (0,002) ***
52462	-0,001 (0,001)	0,005 (0,002) *	0,007 (0,002) **	0,008 (0,003) **	0,016 (0,004) ***
52463	0,000 (0,001)	0,004 (0,001) ***	0,002 (0,001) ,	0,001 (0,001)	0,000 (0,002)
52464	0,003 (0,001) *	-0,001 (0,001)	0,000 (0,002)	0,000 (0,002)	0,006 (0,003) *
52465	0,000 (0,002)	-0,001 (0,002)	0,000 (0,002)	0,001 (0,003)	0,006 (0,004)
52466	0,003 (0,001) **	0,002 (0,001)	0,004 (0,002) *	0,007 (0,002) **	0,009 (0,003) **
52467	0,001 (0,001)	0,003 (0,002)	0,002 (0,002)	0,004 (0,002)	0,008 (0,003) *
52468	-0,002 (0,001) ,	0,003 (0,001) *	0,003 (0,002) ,	0,004 (0,002) *	0,006 (0,002) *
52471	0,003 (0,001) ***	0,002 (0,001) *	0,002 (0,001) ,	0,002 (0,001)	0,002 (0,002)
52472	0,002 (0,001) ,	-0,006 (0,001) ***	-0,007 (0,002) ***	-0,009 (0,002) ***	-0,014 (0,002) ***
52473	-0,003 (0,001) ***	0,002 (0,001)	0,006 (0,002) ***	0,007 (0,002) ***	0,007 (0,002) **
52481	0,001 (0,002)	-0,002 (0,002)	-0,004 (0,002) ,	-0,006 (0,002) **	-0,013 (0,002) ***
52482	-0,001 (0,001)	-0,002 (0,001) **	-0,004 (0,001) ***	-0,004 (0,001) ***	-0,004 (0,001) **
52483	0,006 (0,003) *	0,024 (0,005) ***	0,036 (0,008) ***	0,039 (0,009) ***	0,055 (0,017) **
52484	-0,009 (0,001) ***	-0,002 (0,002)	0,002 (0,002)	0,003 (0,002)	0,003 (0,003)
52485	-0,001 (0,001)	-0,004 (0,001) ***	-0,004 (0,001) ***	-0,003 (0,001) **	-0,005 (0,001) ***
52486	0,000 (0,001)	-0,002 (0,001) *	-0,003 (0,001) *	-0,003 (0,001) *	0,000 (0,002)
52487	0,004 (0,001) ***	0,001 (0,001)	0,001 (0,002)	0,001 (0,002)	0,000 (0,002)
52488	0,001 (0,001)	-0,003 (0,001) ***	-0,006 (0,001) ***	-0,007 (0,001) ***	-0,011 (0,001) ***
52489	0,002 (0,001) ,	0,001 (0,001)	0,000 (0,001)	-0,001 (0,002)	-0,003 (0,002) ,
52491	0,002 (0,002)	0,007 (0,002) ***	0,006 (0,003) *	0,007 (0,003) *	0,010 (0,004) *

Retail continued	15d Estimate(std. Err.)	30d Estimate(std. Err.)	45d Estimate(std. Err.)	60d Estimate(std. Err.)	tot Estimate(std. Err.)
52492	-0,003 (0,001) *	-0,003 (0,001) *	-0,004 (0,002) *	-0,005 (0,002) **	-0,007 (0,002) ***
52493	0,001 (0,001) *	0,000 (0,001)	0,000 (0,001)	-0,001 (0,001)	-0,001 (0,001)
52494	0,004 (0,001) ***	0,001 (0,001)	0,001 (0,001)	0,002 (0,002)	-0,002 (0,002)
52495	0,008 (0,002) ***	0,011 (0,003) ***	0,015 (0,004) ***	0,015 (0,004) ***	0,015 (0,006) *
52496	0,001 (0,001)	0,000 (0,001)	0,000 (0,001)	0,000 (0,001)	-0,002 (0,002)
52497	0,000 (0,000)	-0,005 (0,000) ***	-0,008 (0,000) ***	-0,009 (0,000) ***	-0,012 (0,001) ***
52499	0,003 (0,001) **	0,002 (0,001)	0,004 (0,002) *	0,007 (0,002) ***	0,010 (0,003) ***
52501	-0,001 (0,001)	-0,003 (0,001) ***	-0,005 (0,001) ***	-0,005 (0,001) ***	-0,008 (0,001) ***
52502	0,001 (0,001)	0,001 (0,002)	-0,002 (0,002)	-0,001 (0,002)	-0,001 (0,002)
52503	-0,002 (0,001) ***	-0,005 (0,001) ***	-0,007 (0,001) ***	-0,006 (0,001) ***	-0,005 (0,001) ***
52621	0,005 (0,001) ***	0,003 (0,001) *	0,002 (0,002)	0,002 (0,002)	0,002 (0,002)
52622	0,000 (0,001)	-0,001 (0,001)	-0,001 (0,001)	0,000 (0,001)	-0,003 (0,001) *
52623	0,003 (0,002)	0,002 (0,003)	0,000 (0,003)	0,002 (0,003)	0,003 (0,005)
52624	0,005 (0,001) ***	0,006 (0,001) ***	0,005 (0,001) ***	0,006 (0,002) ***	0,004 (0,002) *
52625	0,003 (0,000) ***	0,001 (0,001) *	0,001 (0,001)	0,001 (0,001)	0,000 (0,001)
52626	0,002 (0,002)	0,002 (0,002)	0,004 (0,003)	0,007 (0,004) *	0,013 (0,006) *
52631	-0,001 (0,001)	0,005 (0,002) *	0,007 (0,003) **	0,007 (0,003) *	0,008 (0,004) *
52632	-0,004 (0,002)	-0,009 (0,002) ***	-0,004 (0,003)	-0,001 (0,004)	0,004 (0,006)
52633	0,001 (0,001)	-0,002 (0,001)	-0,003 (0,002)	-0,001 (0,002)	-0,001 (0,002)
Signif,	codes:	'***' 0,001	'*' 0,05		
		'**' 0,01	',' 0,1		