How accurate are the Swedish forecasters on GDP-growth, CPI-Inflation and unemployment? (1993 – 2001)[1].

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Abstract

This study evaluates the performance of the eight most important Swedish domestic forecasters of real GDP-growth, CPI-inflation and unemployment for the sample period 1993-2001. The evaluation is based on the following measures: mean absolute error, the root mean square error, bias and finally directional accuracy. The forecasts are even compared to naive random walk and random walk with drift models. The results indicate that the current forecasts compared to the year ahead forecasts decline over the forecasting horizons as more information becomes available. The results with respect to the directional accuracy indicate that we are equally good/bad in predicting the directional accuracy for all three macro aggregates. According to the comparisons with the naive random walk model six out of seven Swedish CPI-inflation forecasters were outperformed by the naive random walk model. Tests of bias indicate that the Swedish forecasters underestimate GDP-growth and overestimate CPI-inflation and the unemployment rate for the sample period. All the Swedish forecasters have been successful in predicting the downward trend in CPI-inflation and the unemployment rate. The performance of the Swedish domestic forecasters is better using preliminary GDP-growth outcomes than final. The performance for the current year forecasts is better than the year ahead forecasts for all three macro economic variables. Revisions are positively biased.

Key words
Mean absolute error, root mean square error, directional accuracy, bias, revisions, final respective preliminary outcomes, Theil index, naïve forecasts

1. Introduction

The main purpose of most macroeconomic forecast is as an aid to the rational discussion of economic and policy decision-making. Forecasts of economic variables are important because Governments plan budgets and set macroeconomic policies based on forecasts of future economic activity e.g. money, stock and foreign exchange markets, consumption and investments. Three principles underpin forecasting and they are as follows: (1). There are regularities to capture. (2). Such regularities are informative about the future and finally (3). That there exists a method of capturing them (see Chatfield (1996), Clements and Hendry (1994) and Granger (1996)).

There are many reasons for studying the accuracy of the economic forecasts, including the need to: (1). Identify the sources and thereby the causes of major mistakes, in order to learn from them. (2). To form a rational basis for assessing what kind of policy the accuracy of forecasts typically permits policy makers to make. (3). To be able to recognize in advance the occasion when there is a conjunction of the sort of circumstances that typically lead to large forecasting errors. (See Liewelly and Arai in OECD Studies, 1984).

The National Institute of Economic Research (NIER) periodically reviews its forecasting record as the OECD Secretariat and other National institutes do. Earlier Swedish studies on evaluation of forecasting accuracy in Sweden are Kim (1988), Carling and Kim (1989), Rosenberg (1992), Pernodd (1995), Bergström (1995), Borg (1996), Öller (1996). The earlier studies concentrated on evaluating and comparing accuracy of forecasts in the domestic context with respect to the Theil inequality coefficient (Theil's U) and other measures such as estimating the confidence intervals for forecasts for important macroeconomic variables (see Borg (1996)). However no international comparisons of forecasts were

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made in earlier studies on forecasting evaluation.

In the international context a number of studies have tested a set of projections by generating a battery of diagnostic statistics or by comparing these with naive or mechanical extrapolation (see Clements and Hendry (1997)). Öller and Barot (1998), Öller and Barot (1999) and finally Öller and Barot (2000), concentrated on comparing the OECD Secretariat's GDP-growth and inflation forecasts with that of the European government agencies forecasts. The main results of this study where that overall, inflation forecasts were significantly more accurate than growth forecasts, and in contrast to growth forecasts, they generally improved over time.

Recently Blix et al. (2001, 2002) have evaluated the forecasts for the Swedish economy for the period 1993-2001 using standard statistical measures of forecast error such as the mean prediction error (MPE) and root mean square error (RMSE). A model to capture the potential herd behaviour is used in their study. The overall results from this study indicate that there is a downward bias both for the current year and the next year GDP-growth forecasts. The CPI-inflation forecasts have considerable systematic error, and most forecasters have on the average overestimated inflation during the period 1993-2001. In addition the Ministry of Finance has systematically under estimated unemployment.

In contrast to Blix et al.we even look at the directional accuracy which deserves attention and compare the forecasts with both the naive random walk and random walk with drift models. In addition we calculate the mean absolute and the root mean square error of revisions an aspect neglected in the above mentioned study. The GDP-growth forecasts are evaluated both using final respective preliminary outcomes in order to highlighten the important aspect of revisions. We explicitly define the forecast occasions (spring, summer, autumn and December) that are under scrutinization.

2. The main objective of this study

The main objective of this study is to focus on the major Swedish forecasters. The choice of the Swedish forecasters is based on the availability and timing of forecasts for the period 1993 – 2001. The project was initiated at NIER was limited to merely three central important variables namely GDP-growth, CPI-inflation and unemployment rate. The Swedish forecasters that are under scrutinization are: the National Institute of Economic Research (NIER), Ministry of Finance (FD), the Confederation of Swedish Enterprise (IF), the Swedish Research Institute of Trade (HUI), The Central Bank Sweden (RB), the SEB (SE) group, the Handelsbanken (HB), and finally Merita Nordbanken (NB).

This study assesses the projections of the three most important economic variable GDP-growth, CPI-inflation and unemployment with respect to statistical measures of forecasting accuracy: mean absolute error (MAE), the root-mean squared error (RMSE) and finally directional accuracy (DA). In contrast to Blix et al. we find it appropriate to use the GDP outcomes from Old National Accounts (1993-1998) in order to evaluate the GDP-growth forecasts[2]. The main reason for using the Old National Accounts (1993-1998) is that most of the forecasts were conducted under the Old system of National Accounts. In addition MAE and RMSE of revisions for the GDP-outcomes are calculated. We even look at the directional accuracy of the forecasts and bias. Forecasting accuracy is compared to naive models using Theil U (1966) and Theil W index (see Kennedy (1969)) which was neglected in the above mentioned studies. In contrast to Blix et al. we focus on merely three central variables in this particular study, namely GDP-growth, CPI-inflation, and unemployment which was outlined in this project at NIER.

This type of diagnosis would provide us with valuable insights which may perhaps improve our future forecasts. In addition it will give us, and other forecasting institutes, an insight into how we stand in

2. We have not taken into considerations the most recent revisions in the New National Accounts that took place in December 2002.

our comparisons with other domestic forecasters. It is a fallacy to suppose that there is some single objective test for deciding upon the accuracy of a forecast. Any kind of post - mortem must be made with certain questions in mind. In this particular study we assess the accuracy of both past and recent projections by quantifying the average errors that were made.We explicitly address the following questions:
(1). Has MAE and RMSE for GDP-growth, CPI-inflation and unemployment (UNP) declined over time from spring, summer, autumn to the December forecasts? (i.e. some type of convergence).
(2). Have the GDP-growth, CPI-inflation, and UNP forecasts been able to predict directional accuracy correctly? (i.e. acceleration/decelerations in GDP-growth, CPI-inflation and UNP developments which deserves attention).
(3). Have the GDP-growth, CPI-inflation and the UNP forecasts been better than so called naive method of forecasting such as always predicting forecasts generated by a naive no-change time series model and a naive average growth model?
(4). Have the GDP-growth, CPI-inflation and the UNP forecasts been biased tending to systematically under predict or over predict?

In the process of evaluating the accuracy of the Swedish forecaster's projections, it must be kept in mind that they are not purely model-based numbers though model may play an important role in their elaboration. The final forecast could be a combination of judgemental and model based forecast. In addition it is important to bear two policy aspects related to the forecasting in mind:

(I). The Swedish forecaster's projections are generally based on the assumption of broadly unchanged policies. Two of the forecasters to fall in this category are the Ministry of Finance, Sweden and the National Institute of Economic Research, Sweden.
(II). The Swedish Central Banks inflation forecasts are based on the assumption of an unchanged repo-rate. In order to make a fair comparison one has to adjust CPI-inflation for this assumption. We refrain from comparing the accuracy of the Swedish Central Banks inflation forecasts in this paper.

However the limitations of this exercise should be noted. It merely applies statistical tests below in order to assess the accuracy of the projections (described below). (Neither does it go beyond to assess the reasons why the errors were made). Anyway one can mention in passing that the main source of errors are likely to be found in erroneous assumptions concerning key economic variables, unanticipated changes in policies and the behaviour of economic agents and data revisions (see Economic Outlook (1993) and Öller and Barot).

This study is organised in the following sections. Section 3 describes the data, the time horizon, defines the variables, and the Swedish forecasters coverage. In Section 4 the specific procedures employed in order to evaluate the forecasting accuracy of the projections are discussed. Section 5 presents the results with respect to the different measures. Finally Section 6 concludes.

3. Data

The present study covers the period (1993-2001) and deals exclusively with annual forecasts which seem to be the most relevant for policy decision-making process. The measurement studied is limited to the assements of three key macroeconomic indicators: GDP-growth measured by the change in real gross domestic product (GDP), CPI-inflation-measured by the yearly change in consumer price index (CPI-inflation), and finally the unemployment rate defined as percentage of the labour force. The choice of the forecasters as well as the variables under scrutinization has been conditional by the accessibility of data and the timing of the forecasts. These variables are selected for their obvious importance and because both projection and outcome data for them tend to be available. We have

chosen to evaluate the forecasters who conduct forecasts not so far away in time[3]. Table 1 easily facilitates learning of the names of the Swedish forecasters who are under scrutinization and the average week of the publication of their forecasts.

Table 1 Swedish forecasters

Swedish Forecasters	Average week of the forecast: spring, summer, autumn, December
National Institute of Economic Research (NIER)	13, 25, 36, 49
Ministry of Finance Sweden (FD)	16, NA, 40, NA
Swedish Confederation of Professional (IF)	18, 23, 39,48
Swedish Research Institute of Trade (HUI)	11, 22, 37, 49
The Central Bank of Sweden (RB)	12, 23,42, 49
The Skandinaviska Enskilda Banken (SE)	14, 22, 38, 49
Handelsbanken (HB)	17, 21, 36, 47
Merita Nord Banken (NB).	15, 24, 37, 47

Note: The average week of the forecast is calculated as the mean of the weeks that the forecasts are published.

This information in Table 1 indicates that HUI and RB conduct their forecasts earlier than NIER, followed by SE Banken, Merita Nordbanken, the Ministry of Finance, Handelsbanken and IF. The later one conducts ones forecast implies more information is available to be potentially utilized for the later forecaster to conduct their forecast. Hence any information that is publicly available could be incorporated in the later forecaster's projection. This implies that one can use a model to test if the later forecasters use the information available from earlier forecasters (see Romer and Romer (1996)). We refrain form this aspect mainly due to the limited number of observations and degrees of freedom. In addition we can address the question as suggested by the editor of the Brussels Economic Review if the timing of the forecast coincides with the availability of key new information. According to Blix et al. forecasters use large number of sources and different data sets when they conduct their forecasters. In addition big forecasters like NIER and the Central Bank have large man power resources compared to Handelsbanken or the Swedish Research Institute of Trade. More resources allocated to the forecasting activity should imply better forecasting accuracy.

We classify our spring, summer, autumn and December forecasts in the following manner. The spring forecasts are the forecasts conducted under the first (18) weeks from the beginning of the year. The summer and autumn forecasts are the forecasts conducted during weeks (19-31), and weeks (32-44) respectively. Lastly the December forecasts are the forecasts that are published during weeks (45-52). Hence we evaluate four forecasts per year for the period 1993-2001.

For particular years some institutes have not conducted a forecast and hence there are missing observations. In order to fill up the missing observations we have taken the mean of two earliest available forecasts for the particular institution under scrutinization and for that particular quarter concerned. We have in this manner taken the mean of (the first and the third quarter) for the GDP-growth, CPI-inflation and unemployment forecasts for NIER in order to fill up the second quarters of 1993, 1994 and 1999. Apparently no forecasts were conducted for the year 1999 as the National Accounts were in a phase of transition from Old to New National Accounts. Similarly the mean has been taken in order to fill missing observations for the Swedish Confederation of Professional (IF) for one of the quarter's specific for the year 1994. The same method has been applied to fill the missing

3. Most of the domestic forecasters conduct forecasts on the Swedish economy four times a year (i.e. approximately every quarter).

forecasts for NB for the second quarter of 1993. SE bank has missing observations for the second quarter of 1994 and 1997 and hence the same procedure has been applied. Due to unavailability of CPI-inflation and unemployment forecasts from the Swedish Central Bank for the period 1993-1996 we merely evaluate their GDP-growth forecasts as it covers the sample period of this study. The Ministry of Finance conducts forecasts on the Swedish economy merely two times a year in spring and autumn and hence I do not evaluate their summer respective December forecasts.

GDP-growth final outcomes are the outcomes recorded in the National Accounts appearing two year after the period covered by the forecast e.g. the 1993 "outcome" is that reported in 1995. As most of the forecasts were made in the Old system of National Accounts we use the GDP-growth outcomes from the Old system of National Accounts from 1993-1998 but the new from 1999-2001 (see Öller and Hansson 2005 for the GDP-growth statistics from the Old National Accounts). The New system of National accounts was introduced in 1999. There have been some sectorial definitional changes in the new system and revisions of National Accounts. According to Gust et al. (2001), the switch to the New National Accounts raises both the level and growth rates of GDP relative to the Old system (by about one percentage point for Sweden).

The Swedish forecasts are thus the current GDP-growth forecasts at time (t) and GDP-growth a year ahead projections at time ($t+1$). The GDP realizations refer to the period ($t+2$). The forecasts are the spring, summer, autumn and December forecasts respectively for the current (t) and a year ahead ($t+1$). The GDP-growth, CPI-inflation and the unemployment forecasts have been collected from several numbers of the respective forecasters own publications (see references for the names of the publications for Swedish forecasters).

The definition of the actual outcome for a given period in the past is by no means straightforward. Large successive revisions of the National Accounts, which often occur a considerable time after the publications of the first preliminary estimates, can make definitions of "outcome" rather difficult and to some extent arbitrary. In addition a different kind of problem arises in so far as the "actual" change in GDP-growth is seldom, if ever known unambiguously. The problem of data revisions is insoluble with the reservation for CPI-inflation (i.e. there is a law in Sweden which prohibits revision of CPI-inflation. Such aspects as revisions with combination of measurements errors are always present in context of forecasting. We have tried to compare the forecasts which more or less made in the same time period. It is of considerable importance to bear in mind that the outcome and forecast figures are defined in the same unit of measurement. This implies that outcomes are not gathered too far away in time from the forecast time - point (see Bergström (1995) for more elaborations).

4. Statistical measures for judging the accuracy of projections

4.1. The mean error, the average absolute error and root mean square error

Our main focus on assessing forecasting accuracy is based on the following three statistical measures: the mean error or bias (ME), the average absolute forecast error (MAE), the root - mean squared error (RMSE), which describes the dispersion of the forecast error around zero, and finally the Theil U (1966) statistic. The simplest of measures is to compute the mean error or bias (ME) or mean absolute error (MAE).

ME is computed as:

$$ME = \frac{1}{n}\sum(P_t - A_t) \tag{1}$$

where: *P* denotes the forecast and *A* is the outcome. ME indicate whether systematic over - or under prediction is present. This measure is equivalent to (4) described later. MAE directly measures forecast accuracy and is computed as follows:

$$MAE = \frac{1}{n} \sum | P_t - A_t | \tag{2}$$

This is the average of all the differences between forecast and actual values, disregarding the sign of the error. Hence a forecast that was 1% too low (a bias of +1%) and another that was 1% too high (a bias of 1%) would both represent absolute errors of 1%. The shortcomings of (1) and (2) error measures are that they give no special weight to large errors as is implied, for instance by quadratic loss function (the concept of quadratic loss function is broadly that the loss due to the prediction error is proportional to the square of the error) and that they take no account of the inherent variability of the series). RMSE implicitly assumes that the seriousness of any error in arises sharply with square of the size of the error, so that an error of $\pm 2\%$ is treated as four times (2^2) as important as an error of $\pm 1\%$. It must be pointed out that large errors influence RMSE more than MAE because of squaring of the errors and is computed with the formula below

$$RMSE = \sqrt{\frac{1}{n} \sum (P_t - A_t)^2} \tag{3}$$

4.2. Bias

Efficiency and lack of bias are desirable properties of projection errors. A projection is described unbiased if its average error over time is zero. The test for bias involves checking the statistical significance of the coefficient from a regression of the projection errors on a constant see equation (4). The null hypothesis is that α should have a zero value. In case α is significant it indicates bias. Bias can be interpreted as optimism or pessimism while conducting the forecast.

$$e_t = \alpha (K) + \varepsilon_t \tag{4}$$

In equation (4), e_t equals the forecast error and ε_t the regression error and finally K denotes the constant. The forecast average bias is defined as the average difference between the forecast and the actual value of each variable. A positive value for bias indicates that on average the whole run of forecast for a particular variable, the actual value was over estimated, so that the forecasts were too high. A negative bias indicates that on average the actual were too high. If the estimated α which is the average forecast error is negative and significant, a negative bias exists. Analogously we calculate bias for revisions. The results indicate that on the average the bias is of the magnitude *0.4*, implying that the preliminary GDP-growth outcome is revised upwards for the period 1993-2001.

4.3. Directional accuracy

The analysis of directional accuracy scrutinizes whether or not the variable being projected actually moved in the same direction relative to its value in year *t-1*. It should be mentioned that that the size of the error is not considered under this test. However it would be of utmost interest to know whether a target variable such as CPI-inflation, for example moves in the intended direction. In order to operationlize the concepts of acceleration and deceleration, we look at the accuracy of direction of

forecast for the current period to the next period and the actual of the current period to the actual of the next period. Directional accuracy is defined as:

$$\Delta P_t = P_t - A_{t-1} \tag{5}$$

Where P_t = denotes the current year forecast

$$\Delta A = A_t - A_{t-1} \tag{6}$$

where A is the first available actual value. If P_t and A_{t-1} have opposite signs, an acceleration deceleration is missed. If P_t and A_{t-1} have the same sign, acceleration/deceleration is predicted. Similarly, there is, or is not, an acceleration/ deceleration actual turning point depending on whether A_t and A_{t-1} have the same signs. There are four different qualitatively different outcomes, two correct and two incorrect. The outcome is defined to be correct if both P and A have the same signs, or if both are either positive or negative. The outcome is considered incorrect if P and A take on different signs (see Beach et al. 2002).

The formula to obtain the percentage of correct forecasts is as follows:

$$\%\ correct\ \ forecasts = \frac{number\ of\ \ correct\ \ forecasts\ (same\ sign)}{number\ of\ \ total\ outcomes} \tag{7}$$

For each variable studied, the number of each of the four possible pairings of projections and outcome direction of change is tallied; this information is then used to construct a test of null hypothesis of independence (lack of a relationship) between the direction of projected and actual change. This hypothesis is not tested in this study.

4.4. Naive forecasts

The Theil U (seeTheil (1966)) is a measure of the degree to which one time series (X_t) differs from another (Y_t). Hence Theil-statistic is the ratio of RMSE of the forecast by a particular institute to the RMSE of the random walk forecast (naive no change forecast). The ratio of Theil U for the particular institute to that of the naive model is then computed. The naive model utilized assumes that the growth rate in the year t equals the growth rate in the previous year i.e. gdp-growth $_t$ = gdp-growth $_{t-1}$. The U measure has the following properties: (1). $0 < U < \infty$, as forecasting errors grow. (2). $U = 0$, when forecast are perfect i.e. all $P_t = A_t$. (3). $U > 1$, if a set of forecasts has an inequality coefficient U which approaches or is greater than 1 then it is clearly fairly poor (i.e. the forecast has on average wrong direction). With perfect forecasting, $P = A$, and U therefore zero. As forecasting errors grow, U rises and has no upper bounds. Theil's inequality measure (U) accomplishes two things. It scales the RMSE by the variability of the underlying data, and it offers a way of evaluating forecasting performance relative to a ”naive” forecast of no change in the growth rate between *t-1* and *t*. A Theil's U of less than 1 is said to beat the naive forecast. A RMSE error can be divided also with the average variation (taking an average of the series) to obtain a V measure, which compares forecast to average of the actual variable. A V measure is usually more stringent criterion of accuracy than a U, because the average of economic variables deviates from zero. This is equivalent to the 'random walk with drift' naive alternative. This question amounts to a comparison of the accuracy of the Swedish forecasters with the performance of a '*naive forecaster*' who, regardless of the state of the economy, always predicted the

average rate of change of GDP-growth (see Dean (1976) and Kennedy (1969)). Here it is assumed, for convenience, that the naive forecaster knew in advance what the average would be. Dividing the RMSE by the average of the actual would give us the Theil's V.This makes the yardstick of comparisons more realistic rather than assuming a *'completely naive model'*. It is a well established fact that certain economic variables are more erratic than others, and thus should be difficult to predict. The computation of standard deviation indicates whether the variability in the GDP-growth variable is large or small. In case a strong trend is present, a large standard deviation need not imply that the series is irregular and difficult to predict.

5. Results

5.1. GDP-growth forecasts

In Tables 2 and Table 3 below we present the accuracy of the GDP-growth forecasts with respect to both the final and the preliminary outcomes of GDP-growth from the Old National Accounts. The results indicate that both MAE and RMSE for the current year forecast declines over time from the march to the December forecast irrespective if one uses preliminary or final outcomes, for all the forecasters with the exception for NIER. Nevertheless the results from both MAE and RMSE (see Table 3 and Table 5) indicate that the Swedish forecasters have easier to deal with the preliminary outcomes rather than final outcomes. The shortcomings of MAE error measure is that no special weight is given to large errors. Calculating the MAE and RMSE of revision errors defined as the difference between the final and the preliminary outcomes comes to *0.43* and *0.59* for the current period and *0.48* and *0.62* for the forecast for the next year. The forecasts conducted in Sweden by the forecasting institutions are to a large extent based on the actual prevailing at the time when the forecasts are conducted and the availability of new information which is based on surveys and leading indicators. In this context the revisions do *de facto* play a significant role. The magnitude of revision is reported in Table 2, column 6.

Table 2. MAE: Spring / Summer Autumn / December. GDP-growth (t). Final outcomes: Old National Accounts 1993-2001

	MAE (t) (Spring)	MAE (t) (Summer)	MAE (t) (Autumn)	MAE (t) (December)	MAE (t) (Revisions)
NIER	0.91	0.77	0.44	0.60	0.43
FD	0.87	NA	0.52	NA	0.43
HUI	1.16	1.03	0.76	0.61	0.43
IF	1.22	1.02	0.80	0.72	0.43
SE	1.02	0.80	0.64	0.33	0.43
NB	1.03	1.06	0.74	0.56	0.43
RB	1.06	0.96	0.60	0.58	0.43
HB	1.24	0.99	0.72	0.53	0.43
Avg.	**1.06**	**0.95**	**0.65**	**0.56**	**0.43**

Note: NA indicates not available. A MAE revision is defined as the difference between the final and preliminary outcome. Avg. denotes the average which is the mean of MAE.

Comparing the results of this study with Öller and Barot (1980-1998) in order to get a longer historical perspective the MAE for the current year GDP-growth forecasts was *0.8*, *0.6* and *0.6* for NIER's spring, autumn and December forecasts. This has the implication that with respect to GDP-growth forecasts, that NIER has *de facto* decreased and than increased its MAE marginally for the spring and autumn forecast respectively. The calculated MAE value remains unchanged for the December forecast (see Table 2, columns 2, 4, and 5). The results with respect to RMSE using final respective preliminary outcomes are presented in Table 4 and Table 5.

Table 3. MAE: Spring / Summer / Autumn / December. GDP-growth (t). Preliminary outcomes: Old National Accounts 1993-2001

	MAE (t) (Spring)	MAE (t) (Summer)	MAE (t) (Autumn)	MAE (t) (December)
NIER	0.57	0.40	0.39	0.41
FD	0.59	NA	0.40	NA
HUI	0.77	0.69	0.41	0.38
IF	0.79	0.59	0.39	0.33
SE	0.70	0.52	0.39	0.28
NB	0.67	0.67	0.44	0.30
RB	0.71	0.57	0.26	0.28
HB	0.72	0.64	0.42	0.34
Avg.	**0.72**	**0.58**	**0.39**	**0.33**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

The increase in MAE in the December forecasts is due to revisions of the preliminary actual. It must be pointed out that NIER's MAE, increases during the December forecast. This can be due to the first revisions of GDP-growth are published in December which could have totally changed the picture how the economy would evolve in the last quarter. For all the other forecasters MAE decreases on the average as we reach the end of the forecasting round in December, hence the last quarter of the year. The computed forecasting errors indicate that the situation is almost identical when we analyze the forecasting performance utilizing preliminary data.

Table 4. RMSE: Spring / Summer/ Autumn / December. GDP-growth (t). Final outcomes: Old National Accounts 1993-2001

	RMSE (t) (Spring)	RMSE (t) (Summer)	RMSE (t) (Autumn)	RMSE (t) (December)	RMSE Revisions
NIER	1.18	0.87	0.52	0.75	0.59
FD	1.11	NA	0.56	NA	0.59
HUI	1.29	1.21	0.88	0.77	0.59
IF	1.49	1.16	1.00	0.80	0.59
SE	1.23	0.95	0.78	0.46	0.59
NB	1.30	1.23	1.02	0.76	0.59
RB	1.23	1.09	0.76	0.71	0.59
HB	1.41	1.16	0.82	0.57	0.59
Avg.	**1.28**	**1.10**	**0.79**	**0.69**	

Note: NA indicates not available. Avg. denotes the average which is the mean of RMSE.

RMSE is of importance as it shows the size of average prediction, error, ignores the direction, but gives greater weight to large errors. The RMSE for the current year forecast suggests a pattern similar to the MAE such that the Swedish forecasters find the preliminary figures easier to deal with than the final ones. There is a tendency for RMSE for the current forecasts to decline over the forecast horizon on the average with the reservation for NIER and HUI (see Table 4 and Table 5).

The standard deviation of the preliminary GDP-growth output growth is *1.8*, which is less than the final outcome growth figure of *2.07*. This implies that it would be easier to forecast with preliminary than final outcomes are less volatile. The RMSE of revisions is reported in Table 4, column 6. The results indicate that NIER's December forecasts are poor compared to the spring, summer and autumn forecasts. In the ranking NIER seems to lose its predominant position during the December forecasts.

Table 5. RMSE: Spring / Summer / Autumn / December. GDP-growth (t). Preliminary outcomes: Old National Accounts 1993-2001

	RMSE (t) (Spring)	RMSE (t) (Summer)	RMSE (t) (Autumn)	RMSE (t) (December)
NIER	0.80	0.48	0.47	0.55
FD	0.79	NA	0.44	NA
HUI	0.93	0.84	0.50	0.55
IF	1.02	0.65	0.47	0.38
SE	0.89	0.62	0.47	0.36
NB	0.92	0.81	0.54	0.35
RB	0.85	0.70	0.32	0.30
HB	1.15	0.79	0.52	0.40
Avg.	**0.92**	**0.70**	**0.47**	**0.41**

Note: NA indicates not available. Avg. denotes the average which is the mean of RMSE.

The MAE and RMSE results for GDP-growth a year ahead forecasts using both preliminary and final outcomes are reported in Tables 6, Tables 7, Tables 8 and Table 9. The results indicate with respect to both the measures that the errors do not decline over time as more information becomes available. There is systematic pattern in the December forecast specifically with respect to increases in the error. It should be pointed out that one would expect the forecasting errors to decrease as more information becomes available. This issue needs further scrutinization and analyses as it is an important finding of this study. The MAE and RMSE of revisions for the one year ahead forecasts are reported in Table 6, column 6, and Table 8, column 6. Calculating simple correlations between the revisions and the forecasting errors indicate that all of the forecasters have high negative correlations at 5% significance level[4].

Comparing the results of this study with Öller and Barot (2000), in order to get a longer historical perspective the MAE for the year ahead GDP-growth forecast MAE for the period 1980-1998 (for spring only from1990), autumn and December a year ahead forecasts were *1.5*, *1.1* respective *0.9*. Comparing these results with the one in Table 6 for NIER indicates marginal improvement for the march forecast, unchanged magnitude of MAE for the autumn forecast, and substantial deterioration for the December forecasts. The MAE and RMSE results for one year a head forecasts in Table 8 and Table 9 indicates once again that similar to the current forecasts that it is easier to forecast with preliminary GDP-growth outcomes than using the final outcomes. The standard deviation of the GDP-growth final outcomes is 2*.07* while GDP-growth preliminary is *1.80* for the current period and is *1.25* and *1.04* respectively for the period 1994-2001. The final outcomes are more volatile than the preliminary ones. Both Tables 8 and Table 9 indicate with respect to RMSE that as more information becomes available the RMSE increases systematically for most of the Swedish forecasters with the exception of NB and HB (see Table 9), where it remains unchanged. This seems to be strange as we would expect the errors to decrease as more information becomes available, as mentioned earlier. RMSE in Table 8 and Table 9 for all the Swedish forecasters increases as more information becomes available. This indicates that there is a tendency to some type of flock behavior (keeping up with the Jones). In addition we are inclined to believe that the Swedish forecasters seem to be using the same information set. The RMSE of revisions is reported in Table 8, column 6. The Swedish forecasters have difficulties dealing with a year ahead GDP-growth forecasts. The performance using preliminary GDP-growth figures is better than the final ones, even for the year ahead projections. This implies that the forecasters have some problems with the magnitude of revisions.

Table 6. MAE: Spring / Summer/ Autumn / December. GDP- growth (t+1).

4. A positive correlation indicates that the variables move in the same direction, while a negative correlation implies that they move in opposite directions which seem contradictory.

Final outcomes: Old National Accounts 1994-2001

	MAE (t+1) (Spring)	MAE (t+1) (Summer)	MAE (t+1) (Autumn)	MAE (t+1) (December)	MAE (t+1) Revisions
NIER	1.36	1.10	1.05	1.26	0.48
FD	1.23	NA	1.06	NA	0.48
HUI	1.44	1.43	1.19	1.28	0.48
IF	1.53	1.65	1.40	1.51	0.48
SE	1.33	1.10	1.06	1.15	0.48
NB	1.13	0.95	1.04	1.06	0.48
RB	1.16	1.09	1.10	1.26	0.48
HB	1.49	1.36	1.30	1.35	0.48
Avg.	**1.33**	**1.24**	**1.15**	**1.27**	

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Table 7. MAE: Spring / Summer / Autumn / December. GDP-growth (t+1). Preliminary outcomes: Old National Accounts 1994-2001

	MAE (t+1) (Spring)	MAE (t+1) (Summer)	MAE (t+1) (Autumn)	MAE (t+1) (December)
NIER	0.99	0.75	0.73	0.89
FD	0.85	NA	0.84	NA
HUI	1.06	1.03	0.86	0.95
IF	1.33	1.23	0.98	1.04
SE	0.90	0.73	0.79	0.88
NB	0.98	0.80	0.84	0.74
RB	0.86	0.71	0.70	0.84
HB	1.11	1.01	1.00	1.03
Avg.	**1.01**	**0.89**	**0.84**	**0.91**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Table 8. RMSE: Spring / Summer / Autumn / December. GDP-growth (t+1). Final outcomes: Old National Accounts 1994-2001

	RMSE (t+1) (Spring)	RMSE (t+1) (Summer)	RMSE (t+1) (Autumn)	RMSE (t+1) (December)	RMSE Revisions
NIER	1.49	1.30	1.29	1.45	0.62
FD	1.36	NA	1.25	NA	0.62
HUI	1.57	1.52	1.45	1.54	0.62
IF	1.76	1.82	1.65	1.77	0.62
SE	1.51	1.40	1.29	1.40	0.62
NB	1.28	1.10	1.29	1.36	0.62
RB	1.30	1.25	1.32	1.47	0.62
HB	1.67	1.68	1.63	1.63	0.62
Avg.	**1.49**	**1.44**	**1.40**	**1.52**	

Note: NA indicates not available. Avg. denotes the average which is the mean of RMSE.

This study indicates that revisions are an important aspect that the Swedish forecasters should take into consideration. Many policy-makers both in the private and the public sector use the information contained in the GDP-growth forecast. It is of utmost importance that the Swedish forecasters are able to incorporate the aspects of revisions in their forecasts realialising the fact that a preliminary figure

gets revised and becomes final. The aspects of revisions make decision-and policy making uncertain. In many circumstances, this sort of uncertainty leads to policy caution-smaller moves in interest rates than would be suggested by looking simply at the forecast and ignoring uncertainty.

Table 9. RMSE: Spring / Summer / Autumn / December. GDP-growth (t+1). Preliminary outcomes: Old National Accounts 1994-2001

	RMSE (t+1) (Spring)	RMSE (t+1) (Summer)	RMSE (t+1) (Autumn)	RMSE (t+1) (December)
NIER	1.17	1.00	1.01	1.10
FD	1.05	NA	1.08	NA
HUI	1.28	1.23	1.19	1.26
IF	1.43	1.34	1.17	1.26
SE	1.06	1.03	1.01	1.13
NB	1.17	0.99	1.09	1.09
RB	1.12	1.04	1.10	1.22
HB	1.36	1.34	1.32	1.38
Avg.	**1.21**	**1.14**	**1.12**	**1.21**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Hence we conclude that forecasts cannot be simply accepted at face value by policy-makers. Instead the policy makers must be informed by the forecasts, by the discussion around the forecasts and the forces the forecasters see at work in producing them. In case the final GDP figures would give a totally different view of the economy in comparisons to the preliminary one the investment decisions made would not be optimal. This would imply loss of profits for the firm. Hence revisions may be considered a measure of the price, in terms of accuracy (see Öller and Hansson (2003) for more elaborations). As regards policy the first point which comes to mind is that the tendency of the GDP-growth forecasts is towards underprediction rather than overprediction, so that policy recommendations based upon them would be biased in the direction of overexpansion.

5.2. CPI-inflation forecasts

The accuracy of the CPI-inflation forecasts is presented with respect to MAE and RMSE for the current and one year ahead forecasts in Tables 10 and Table 12 and Tables 11 and Table 13 respectively. The accuracy of CPI-inflation forecasts is much better than the GDP-growth forecast. A simple measure of volatility is the standard deviation. The standard deviation for the current and a year ahead forecasts for CPI-inflation are *1.45* and *1.01* and *2.07* and *1.25* for GDP-growth final outcomes indicating that inflation fluctuates less than final GDP-growth. Both the MAE and RMSE are lower for CPI-inflation than for GDP-growth, suggesting that it is easier to forecast CPI-inflation than GDP-growth (final outcome). CPI-inflation fluctuates less than GDP-growth. Hence both the MAE and RMSE are lower for CPI-inflation than for GDP-growth.

Comparing the results of this study with Öller et al., NIER's the current year, spring, autumn and December forecasts for CPI-inflation during the period 1980-1998, MAE was *0.7*, *0.1* and *0.5* for the spring, autumn and December forecasts and a . Comparing the results with the one presented in Table 10, there has been a marginal improvement in MAE for the spring, the autumn and the December current CPI-inflation forecasts. The CPI-inflation year ahead forecasts for spring, autumn and December forecasts during 1980 – 1998 had a MAE *1.7*, *1.6*, *and 0.9* respectively. This implies that there has been considerable decrease in the magnitude of the errors for the spring and the autumn forecasts (see Table 12 NIER for comparisons) and a substantial improvement in the CPI-inflation forecasting accuracy.

Table 10. MAE: Spring / Summer / Autumn / December. CPI-inflation (t),

1993-2001

	MAE (t) (Spring)	MAE (t) (Summer)	MAE (t) (Autumn)	MAE (t) (December)
NIER	0.53	0.25	0.13	0.06
FD	0.46	NA	0.12	NA
HUI	0.82	0.39	0.30	0.12
IF	0.71	0.44	0.32	0.12
SE	0.58	0.35	0.07	0.17
NB	0.69	0.41	0.18	0.16
RB	NA	NA	NA	NA
HB	0.70	0.32	0.18	0.05
Avg.	**0.65**	**0.36**	**0.18**	**0.08**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Table 11. RMSE: Spring / Summer / Autumn / December. CPI-inflation (t), 1993-2001

	RMSE (t) (Spring)	RMSE (t) (Summer)	RMSE (t) (Autumn)	RMSE (t) (December)
NIER	0.63	0.32	0.18	0.11
FD	0.56	NA	0.16	NA
HUI	0.96	0.48	0.35	0.21
IF	0.89	0.52	0.38	0.14
SE	0.70	0.44	0.10	0.31
NB	0.76	0.48	0.22	0.33
RB	NA	NA	NA	NA
HB	0.88	0.43	0.23	0.08
Avg.	**0.78**	**0.44**	**0.23**	**0.14**

Note: NA indicates not available. Avg. denotes the average which is the mean of RMSE.

The accuracy of the CPI-inflation forecasts is better with respect to both the accuracy measures since the introduction of a regime of inflation targeting in 1993 by the Swedish Central bank which implies that the consumer price index (CPI) has to be targeted to two per cent with a tolerated deviation interval of +/- 1 percentage points. The results do indicate that the downwards trend in CPI-inflation has been captured by most of Swedish forecasters. Current forecasts for both CPI-inflation reveal that both MAE and RMSE declines over time for most of the Swedish forecasters with the exception of SE and NB. The MAE and RMSE error for CPI-inflation for the year ahead forecasts (see Table 12) indicates that MAE declines for almost all the forecasters. As mentioned in the earlier the results that it is easier to forecast for the current period than for the year ahed forecasts.

Table 12. MAE: Spring / Summer / Autumn / December. CPI-inflation (t+1), 1994-2001

	MAE (t+1)	MAE (t+1)	MAE (t+1)	MAE (t+1)

	(Spring)	(Summer)	(Autumn)	(December)
NIER	1.07	0.77	0.83	0.62
FD	0.95	NA	0.79	NA
HUI	1.19	0.96	0.93	0.79
IF	1.06	1.09	1.10	0.74
SE	1.19	1.24	1.04	0.89
NB	1.09	1.07	1.12	0.82
RB	NA	NA	NA	NA
HB	1.34	0.91	0.86	0.66
Avg.	**1.1**	**1.01**	**0.95**	**0.65**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Table 13. RMSE: Spring / Summer / Autumn / December. CPI-inflation (t+1), 1994-2001

	RMSE (t+1) (Spring)	RMSE (t+1) (Summer)	RMSE(t+1) (Autumn)	RMSE(t+1) (December)
NIER	1.21	0.97	0.88	0.76
FD	1.11	NA	0.82	NA
HUI	1.51	1.13	0.94	0.86
IF	1.27	1.33	1.18	0.83
SE	1.62	1.45	1.05	0.87
NB	1.35	1.30	1.09	0.89
RB	NA	NA	NA	NA
HB	1.62	1.31	0.96	0.79
Avg.	**1.28**	**1.13**	**1.11**	**1.00**

Note: NA indicates not available. Avg. denotes the average which is the mean of RMSE.

5.3. Unemployment

The unemployment variable actually has larger standard deviations than the GDP-growth and CPI-inflation, and hence should be more difficult to forecast. Scrutinizing both MAE and RMSE by looking at Table 14 and Table 15, we see a tendency for the forecast errors for the current period to decline for almost all the forecasters. The results indicate convergence as expected.

Analyzing the year ahead forecasts for the employment variable we observe that the MAE errors seem to decrease for the Swedish forecasters with the exception of IF, SE, HB and FD. The same tendency is noticed for RMSE. RMSE declines for NIER, HUI, NB and HB. Larger forecasting errors were made during this period as result of a dramatic increase in the unemployment rate as a consequence of the Swedish recession and the structural break in the unemployment variable during this period.

Table 14. MAE: Spring / Summer / Autumn / December. UNP (t), 1993-2001

	MAE (t) (Spring)	MAE (t) (Summer)	MAE (t) (Autumn)	MAE (t) (December)

NIER	0.48	0.50	0.50	0.40
FD	0.71	NA	0.50	NA
HUI	0.70	0.57	0.50	0.41
IF	0.72	0.59	0.52	0.46
SE	0.66	0.51	0.44	0.43
NB	0.78	0.51	0.52	0.40
RB	NA	NA	NA	NA
HB	0.70	0.48	0.49	0.42
Avg.	**0.68**	**0.53**	**0.50**	**0.42**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Table 15. RMSE: Spring / Summer/ Autumn /December. UNP (t), 1993-2001

	RMSE (t) (Spring)	RMSE (t) (Summer)	RMSE (t) (Autumn)	RMSE (t) (December)
NIER	0.65	0.70	0.69	0.59
FD	0.82	NA	0.67	NA
HUI	0.83	0.72	0.65	0.56
IF	0.91	0.74	0.72	0.64
SE	0.78	0.67	0.65	0.63
NB	0.89	0.68	0.70	0.59
RB	NA	NA	NA	NA
HB	0.95	0.66	0.70	0.63
Avg.	**0.83**	**0.70**	**0.68**	**0.61**

Note: NA indicates not available**.** Avg. denotes the average which is the mean of RMSE.

Table 16. MAE: Spring / Summer / Autumn / December. UNP (t+1), 1994-2001

	MAE (t+1) (Spring)	MAE (t+1) (Summer)	MAE (t+1) (Autumn)	MAE (t+1) (December)
NIER	0.94	0.74	0.75	0.55
FD	0.66	NA	0.75	NA
HUI	0.96	0.74	0.95	0.71
IF	1.00	1.01	0.88	0.96
SE	0.88	0.66	0.74	0.76
NB	0.96	0.90	0.86	0.75
RB	NA	NA	NA	NA
HB	0.78	0.85	0.71	0.74
Avg	**0.88**	**0.82**	**0.81**	**0.75**

Note: NA indicates not available. Avg. denotes the average which is the mean of MAE.

Table 17. RMSE: Spring / Summer / Autumn / December. UNP (t+1), 1994-2001

	RMSE (t+1) (Spring)	RMSE (t+1) (Summer)	RMSE (t+1) (Autumn)	RMSE (t+1) (December)
NIER	1.09	0.93	0.97	0.67

FD	0.88	NA	0.94	NA
HUI	1.06	0.84	1.09	0.83
IF	1.10	1.12	0.99	1.00
SE	1.02	0.79	0.90	1.04
NB	1.10	1.05	1.03	0.93
RB	NA	NA	NA	NA
HB	0.88	0.87	0.83	0.82
Avg.	**1.03**	**0.93**	**0.96**	**0.88**

Note: NA indicates not available. Avg. denotes the average which is the mean of RMSE.

The conclusions with respect to the numerical accuracy using MAE and RMSE for current and next years GDP-growth forecasts indicates that the forecasting accuracy of Swedish forecasting institutions is more accurate using preliminary outcomes than final outcomes. The reason may be mainly due to the fact that GDP-growth final outcomes are more volatile than preliminary. Adding the magnitude of revisions to the GDP-forecasts would improve the GDP-growth forecasting accuracy. The CPI-inflation current forecasts are more accurate than both the GDP-growth and the unemployment forecasts partly due to the fact that GDP-growth is more volatile than CPI. However the year ahead unemployment forecasts are more accurate than CPI-inflation despite higher standard deviation for both current and a year ahead forecasts. The unemployment forecasts have better forecasting accuracy than GDP-growth forecasts. Forecasting accuracy is better for the current year forecasts than the year ahead forecasts for all the variables of the study.

5.4. Directional accuracy of forecasts

Leitch and Tanner (1995) suggest that the numerical accuracy measures (*RMSE*, *MAE*, *MSE*, e.g.) have little relevance for users of forecasts in business enterprises, who seem most concerned with the directional accuracy (acceleration/deceleration) indicated by the forecast. The main reason why the Private Business Sector scrutinizes growth forecasts is decide whether to invest in order to expand production capacity. If the investors receive the wrong signal, the results will be either a loss of market share or excess production capacity. In addition a central bank is interested in accurate inflation targeting. If it can predict whether the inflation rate will accelerate or decelerate, it will know whether and by how much to raise or lower the interest rates. The results of the directional accuracy of the Swedish forecasters with respect to GDP-growth are presented below. The directional forecasting accuracy evaluated using final outcomes is presented in Table 18 using the formula in (7).

One is compelled to ask why certain years are difficult for the Swedish forecasters. It seems these years in particular seem to be the Swedish business cycle. In general the directional accuracy of the Swedish forecasters appears to be weak. The results with respect to directional accuracy using both final and preliminary outcomes indicates that there is not any significant difference in using preliminary respectively final GDP-growth outcomes. In particular one should notice that it is almost the same years that acceleration/deceleration in GDP-growth forecasts were missed. This in turn indicates that the Swedish forecasters have difficulties in dealing with directional accuracy. One can in fact ask the question why the years 1996, 1999 and 2000 were difficult to forecast. In contrast to the numerical accuracy which was more accurate with respect to preliminary data, we do not see any major differences or comparative advantage dealing with preliminary data.

Table 18. Correct forecasts in percentages GDP-growth, CPI-inflation and UNP 1993-2001

Ins.	**Spr GDP**	**Sum GDP**	**Aut. GDP**	**Dec. GDP**	**Spr. CPI**	**Sum CPI**	**Aut CPI**	**Dec CPI**	**Spr UNP**	**Sum. UNP**	**Aut. UNP**	**Dec. UNP**

NIER	63 %	88 %	100 %	63 %	63 %	88 %	75 %	75 %	63 %	63 %	63 %	75 %
FD	75 %	NA	75 %	NA	75 %	NA	75 %	NA	63 %	NA	63 %	NA
HUI	75 %	50 %	63 %	38 %	75 %	50 %	75 %	75 %	50 %	63 %	63 %	63 %
IF	63 %	63 %	75 %	50 %	63 %	63 %	63 %	50 %	50 %	38 %	50 %	63 %
SE	75 %	88 %	75 %	75 %	75 %	88 %	63 %	75 %	63 %	75 %	63 %	63 %
NB	75 %	75 %	88 %	75 %	75 %	75 %	63 %	75 %	63 %	63 %	63 %	63 %
RB	75 %	75 %	63 %	NA	NA	NA	NA	NA	NA	NA	NA	NA
HB	75%	75%	75%	63%	75%	75%	63%	75%	75%	63%	50%	75%

Note: NA indicates not available. We do not conduct the Pearson chi-square test due to the small sample size. Spr, Sum, Aut, and Dec denote spring, summer, autumn and December forecasts.

The results of directional accuracy for the unemployment variable indicates that the Swedish forecasters missed 1994, 1995 and 1996, perhaps partly because the Swedish economy began to slide into recession in the 1990s. First escalating interest rates due to rising budget deficit and then rising unemployment. Prior to the crisis the unemployment rate had been fairly constant. There was a structural break and hence difficult for the Swedish forecasters to predict the directional accuracy correctly. The only common years for the Swedish forecasters when both GDP-growth growth rate and unemployment rate were missed were 1996. The Swedish forecasters nevertheless have been fairly successful in forecasting the downward trends in the unemployment rate from 1997 to 2001. However the directional accuracy has been weak with respect to the years 1994, 1995, and 1996. In fact there was structural break in the unemployment variable (1990-1994) when unemployment dramatically increased from 4 to 12 percent.

The results of directional accuracy with respect to CPI indicate that the years which are common to when acceleration respective deceleration were missed are 1996, 1998 and 1999. The target of the Central Swedish Bank is to limit the annual rate of increase in consumer prices to 2 percent, with a tolerance of 1 percentage point on either side. The development of inflation rate in Sweden is usually based on the relationship between growth and inflation. This is usually based on the so called Phillips – curve model. For illustration purpose, (see the Swedish Economy, June 2002 pp. 66-67), in which the determination of the inflation rate is based on calculations of actual and potential output (which is an unobserved component and could be difficult to estimate). In case, the Swedish economy has a positive output gap due to rising resource utilization, this would lead to excessive increase in prices and wages. Perhaps the outlined model did not work for the years 1996, 1998, and 1999 could partly be due to the revision of GDP prelimnary outcomes.

5.5. Naive comparisons of forecasts

The results with respect to the Theil U index are presented in Table 19 for GDP-growth, Table 20 for CPI-inflation and Table 21 for unemployment. The interpretation of the coefficient is for example in Table 19 for NIER, *U* is *0.77* which indicates that the root mean square error of that set of predictions is *77* per cent of that which would have been observed if 'no change' forecast had been made.

Table 19. Theil U-index GDP-growth final outcomes (t) and (t+1)

Institute	Spring	Sum	Autumn	December	Spring	Sum	Autum	Dec

	(t)	(t)	(t)	(t)	(t+1)	(t+1)	(t+1)	(t+1)
NIER	0.77	0.57	0.34	0.49	0.87	0.76	0.76	0.85
FD	0.72	NA	0.37	NA	0.80	NA	0.73	NA
HUI	0.84	0.79	0.57	0.50	0.92	0.89	0.85	0.90
IF	0.97	0.76	0.65	0.52	1.03*	1.06*	0.96	1.03*
SE	0.80	0.62	0.51	0.30	0.88	0.82	0.75	0.82
NB	0.85	0.80	0.66	0.50	0.75	0.64	0.76	0.80
RB	0.80	0.71	0.49	0.46	0.76	0.73	0.77	0.86
HB	0.92	0.75	0.54	0.37	0.98	0.98	0.95	0.96

Note: NA indicates not available. Figures in FET imply that the naive random walk model beats the forecast conducted by I.F. Spr. and Sum. Denotes spring respective summer forecasts. Asterisk * indicates that the naive random walk alternative is better. IF is the only Swedish forecaster that is beaten by the naïve alternative.

The Theil Inequality Statistic (Theil U) is a measure of the degree to which the forecast differs from the actual. The naive model used assumes that the growth rate in the year equals the growth rate of the previous year. $GDP\text{-}growth_t = GDP\text{-}growth_{t-1}$ .With respect to GDP-growth it is only IF the only forecaster that is outperformed by the naive random walk counterpart. All of the Swedish forecasters outperform the Theil V index. The results are not reported here.

Table 20. Theil U-index CPI-inflation (t) and (t+1), 1993-2001

Institute	Spr.	Sum.	Autumn	December	Spr	Sum	Autumn	Decem
	(t)	(t)	(t)	(t)	(t+1)	(t+1)	(t+1)	(t+1)
NIER	0.46	0.19	0.12	0.08	0.91	0.81	0.90	0.76
FD	0.46	NA	0.13	NA	0.93	NA	0.83	NA
HUI	0.72	0.35	0.26	0.16	1.26	0.95	0.94	0.86
IF	0.46	0.39	0.28	0.10	1.07*	1.11*	1.18*	0.83
SE	0.52	0.31	0.07	0.18	1.35*	1.21*	1.05*	0.88
NB	0.57	0.39	0.15	0.06	1.13*	1.08*	1.03*	0.89
RB	NA	NA	NA	NA	NA	NA	NA	NA
HB	0.66	0.32	0.17	0.17	1.30*	1.10*	0.96	0.79

Note: NA indicates not available. For the CPI-inflation a year ahead forecasts the naive random walk model beats the forecast conducted by IF, SE, NB and HB. Spr. and Sum. denotes spring respective summer forecasts. Asterisk * indicates that the naive random walk alternative is better. IF, SE, NB and HB are beaten by the naive random walk model.

Table 21. Theil U-index unemployment (t) and (t+1), 1993-2001

Institute	Spr	Sum	Autumn	December	Spr	Sum	Autumn	Decem

	(t)	(t)	(t)	(t)	(t+1)	(t+1)	(t+1)	(t+1)
NIER	0.25	0.28	0.27	0.23	0.44	0.37	0.39	0.27
FD	0.32	NA	0.27	NA	0.35	NA	0.38	NA
HUI	0.33	0.28	0.26	0.22	0.43	0.34	0.44	0.33
IF	0.36	0.29	0.28	0.25	0.48	0.45	0.40	0.40
SE	0.31	0.27	0.26	0.25	0.41	0.32	0.36	0.42
NB	0.35	0.27	0.28	0.23	0.44	0.42	0.41	0.37
RB	NA	NA	NA	NA	NA	NA	NA	NA
HB	0.37	0.26	0.2	0.25	0.35	0.35	0.33	0.33

Note: NA indicates not available. Spr. denotes spring, Sum. Denotes summer.

Dividing the RMSE by the mean of final GDP-growth outcomes which is *2.36* for the sample period one obtains the Theil V for the current forecasts. In order to get the Theil V for the year ahead forecasts one takes a ratio of RMSE to the mean of final outcomes for the period 1994-2001, which is *2.45*. It's astonishing that most of the Swedish GDP-growth forecasters outperform the Theil V counterpart which could be considered more sophisticated than the Theil U. In Table 20 the results with respect to Theils U index are presented for CPI-inflation for both the current and next years forecasts. The results indicate that four out of seven forecasters are outperformed by the naive forecast for next years inflation projections. Nevertheless most of the CPI-inflation forecasters beat the Theil V naive model. Dividing RMSE by the mean of CPI one obtains the mean to be *1.80* and *1.43*. All the forecasters outperform the naive model with respect to the unemployment variable.

Our evaluation with respect to the TheilU-index indicates that the Swedish forecasters are good at forecasting unemployment and GDP-growth, in the sense of outperforming a naive model, but not as good as they are at forecasting the CPI-inflation. In order to evaluate the Theil V naive model divide RMSE by the mean of the actual of unemployment which is *6.42* and *6.20*. All of the Swedish forecasters beat the naive Theil V model.

5.6. Bias

The test of bias is based on equation (4) which is equivalent to (1). The results of the bias in the GDP-growth current and one year ahead forecasts are presented in Table 22 and Table 23. A forecast error that is larger than the actual outcome indicates a positive bias represented by a positive error term and vice versa. Merely IF have a negative bias in their year ahead autumn and December forecasts which is significant at 5% significance level. Most of the Swedish forecasters are under predicting GDP-growth outcomes. Almost all the GDP-growth forecasts for the current year are unbiased with the exception of IF. IF: s next years forecast is biased at 5% significant level. The results once again indicate negative bias indicating that the forecast underestimate the GDP-growth outcomes.

Table 22. Test for bias in the GDP-growth (t), 1993-2001

Inst	Spring	Summer	Autumn	Dec

	Coeff.	T-Stat	Coeff	T-Stat	Coeff.	T-Stat	Coeff	T-Stat
NIER	-0.36	0.90	-0.39	1.40	-0.18	1.02	-0.29	1.18
FD	-0.28	0.76	NA	NA	-0.21	1.14	NA	NA
HUI	-0.24	0.55	-0.30	0.72	-0.27	0.89	-0.30	1.19
IF	-0.80	1.80	-0.69	2.08**	-0.62	2.26**	-0.48	2.09**
SE	-0.24	0.57	-0.22	0.68	-0.28	1.12	-0.22	1.57
NB	-0.50	1.30	-0.54	1.40	-0.41	1.25	-0.36	1.49
RB	-0.32	0.77	-0.31	0.84	-0.33	1.38	-0.38	1.79
HB	0.00	0.00	-0.21	0.53	-0.21	0.75	-0.22	1.19

Note: NA indicates not available. Bias shows t-test values of the arithmetic average where ** denotes statistically significance on the 5% level. For d.f. =8, the 5% significance is t =1.86. For the two tailed test 5% significance is t = 2.31.

According to Blix et al. (pp. 51), the underestimation of net exports significantly contributes to the downward bias for both the current and next-year GDP-growth forecasts. The test on bias based on (1) or (4) with 9 observations for the current year forecasts and 8 observations for the year ahead forecasts respectively. The results on bias indicate that most of the Swedish forecasters are unbiased, except for the I.F. For the current period CPI-inflation forecasts, contrary to the GDP-growth forecasts, we have positive bias. The forecasts are larger than the outcomes, implying that we are overestimating the CPI actual. In particular, HB, HUI, NB and SE's CPI-inflation forecasts for the current period are biased and significant on the 5% level.

Table 23. Test for bias in the GDP-growth year (t+1), 1994-2001

Inst.	Spring		Summer		Autumn		Dec	
	Coeff.	T-Stat	Coeff	T-Stat	Coeff.	T-Stat	Coeff	T-Stat
NIER	-0.34	0.62	-0.23	0.46	-0.23	0.47	-0.31	0.58
FD	-0.40	0.81	NA	NA	-0.06	0.13	NA	NA
HUI	-0.54	0.96	-0.43	0.77	-0.16	0.30	-0.23	0.39
IF	-0.63	1.00	-1.03	1.81	-0.77	1.41	-1.03	1.92**
SE	-0.65	1.27	-0.35	0.68	-0.14	0.28	-0.15	0.28
NB	-0.63	1.00	-0.18	0.43	-0.16	0.34	-0.21	0.42
RB	-0.19	0.39	-0.19	0.40	-0.10	0.20	-0.24	0.43
HB	-0.41	0.67	-0.44	0.71	-0.23	0.37	-0.10	0.16

Note: NA indicates not available. Bias shows t-test values ** denotes statistically significance on the 5% level. For D.F. = 8, the 5% significance level is t =1.86. For the two tailed test 5% significance is t = 2.31.

Table 24. Test for bias in the CPI-inflation (t), 1993-2001

Inst	Spring	Summer	Autumn	Dec

	Coeff.	T-Stat	Coeff	T-Stat	Coeff.	T-Stat	Coeff	T-Stat
NIER	-0.05	0.24	0.02	0.29	0.04	0.66	-0.05	1.50
FD	-0.00	0.03	NA	NA	0.05	0.85	NA	NA
HUI	0.46	1.54	0.29	2.22**	0.14	1.22	-0.05	0.68
IF	0.40	1.43	0.19	1.14	0.15	1.23	-0.05	1.13
SE	0.24	1.08	0.23	1.99**	0.06	2.11**	0.08	1.05
NB	0.02	0.06	0.09	0.51	0.11	1.97**	0.05	2.25**
RB	NA	NA	NA	NA	NA	NA	NA	NA
HB	0.49	1.91**	0.15	1.05	0.04	0.46	-0.02	1.50

Note: NA indicates not available. Bias shows t-test values of the arithmetic average where ** denotes statistically significance on the 5% level. For d.f. =8, the 5% significance level is 1.86. For the two tailed test t test 5% significance level is t = 2.31.

Looking at Table 25, six out of seven year ahead CPI-inflation forecasts are biased, at the statistically significant 5% level. NIER is the only CPI-inflation forecaster that is unbiased. According to Diebold et al. (1997) have found a tendency to under-estimate inflation during episodes of high inflation and over-estimate it in period of low inflation. This seems to be the case for Sweden to a certain extent. The test for bias presented in Table 26 below, with respect to the unemployment variable for the current period forecasts indicates that bias is significant for NB, HB and IF at the 5% significance level. The unemployment rate is overestimated. Contrary to Blix et al., we do not find any statistical significant evidence of underestimation of the unemployment variable for FD.

Table 25. Test for bias in the CPI-inflation (t+1), 1994-2001

Inst.	Spring		Summer		Autumn		Dec	
	Coeff.	T-Stat	Coeff	T-Stat	Coeff.	T-Stat	Coeff	T-Stat
NIER	0.52	1.44	0.42	1.27	0.43	1.16	0.33	1.04
FD	0.70	2.20**	NA	NA	0.48	1.48	NA	NA
HUI	1.10	2.79**	0.73	2.24**	0.75	2.41**	0.53	1.59
IF	0.88	2.54**	0.92	2.54**	0.80	1.81	0.43	1.28
SE	1.18	2.85**	1.23	4.32**	0.96	3.13**	0.76	2.73**
NB	0.82	2.01**	0.84	2.28**	0.66	1.67	0.46	1.22
RB	NA	NA	NA	NA	NA	NA	NA	NA
HB	1.15	2.88**	0.83	2.18*	0.72	2.15	0.53	1.81

Note: NA indicates not available. Bias shows t-test values of the arithmetic average where ** denotes statistically significance on the 5% level. For d.f. = 8, the 5% significance is t =1.86. For the two tailed test t test 5% significance level is t = 2.31.

Table 26. Test for bias in the UNP (t), 1993-2001

Inst	Spring	Summer	Autumn	Dec

	Coeff.	T-Stat	Coeff	T-Stat	Coeff.	T-Stat	Coeff	T-Stat
NIER	0.34	1.78	0.32	1.45	0.30	1.36	0.28	1.59
FD	0.37	1.78	NA	NA	0.25	1.16	NA	NA
HUI	0.23	0.83	0.34	1.55	0.38	2.11	0.27	1.60
IF	0.23	0.75	0.34	1.49	0.30	1.29	0.39	2.18**
SE	0.27	1.08	0.29	1.34	0.31	1.53	0.30	1.52
NB	0.44	1.63	0.40	2.04*	0.43	2.22**	0.31	1.76
RB	NA	NA	NA	NA	NA	NA	NA	NA
HB	0.14	0.44	0.30	1.45	0.31	1.41	0.33	1.78

Note: NA indicates not available. Bias shows t-test values of the arithmetic average where ** denotes 5% significance. For d.f. =8, the 5% significance is t =1.86. For the two tailed test t test 5% significance level is t = 2.31.

27. Test for bias in the UNP (t+1), 1994-2001

Inst	Spring		Summer		Autumn		Dec	
	Coeff.	T-Stat	Coeff	T-Stat	Coeff.	T-Stat	Coeff	T-Stat
NIER	0.56	1.60	0.36	1.12	0.35	1.03	0.17	0.72
FD	-0.08	0.26	NA	NA	0.05	0.14	NA	NA
HUI	0.33	0.89	0.38	1.38	0.57	1.64	0.33	1.18
IF	0.50	1.23	0.81	2.81**	0.67	2.45**	0.63	2.19**
SE	0.43	1.21	0.30	1.11	0.38	1.26	.0.41	1.14
RB	NA	NA	NA	NA	NA	NA	NA	NA
NB	0.44	1.15	0.57	1.73	0.61	1.97**	0.48	1.58
HB	0.20	0.62	0.48	1.72	0.48	1.92**	0.46	1.79

Note: NA indicates not available. Bias shows t-test values of the arithmetic average where ** denotes 5% significance. For d.f. =8, the 5% significance is t =1.86. For the two tailed test t test 5% significance level is t = 2.31.

The results of the year ahead unemployment forecasts indicates that HB, IF and NB forecasts are biased. They overestimate the unemployment variable.

6. Conclusions

The main objective of this study has been to assess the accuracy of the Swedish domestic forecasters with respect to GDP-growth, CPI-inflation and the unemployment variable. The measures of accuracy that have been employed are ME, MAE, RMSE, and directional accuracy. The results indicate:
1). The average errors for a year ahead growth, inflation and unemployment are large in terms of both their variance and the importance of the variables. The Swedish forecaster's performance is better at using preliminary than final GDP-growth outcomes. This can cause uncertainty in both the decision and policy making process.
2). Accuracy measured by RMSE and MAE are significantly higher for growth than for CPI-inflation and unemployment.
3). Directional accuracy analysis indicates that we are equally good /bad in predicting the directional accuracy for GDP-growth, CPI-inflation, and employment. The years that we are having problems in predicting GDP-growth are common to all the Swedish forecasters (1996, 1999, and 2000). Directional accuracy that was missed for CPI-inflation is (1996, 1998, and 1999). Lastly acceleration/deceleration

has been missed for the unemployment variable during the years (1994, 1995, and 1996). This is mainly due to a structural break in the unemployment variable. An important gauge of the forecasts ability to determine acceleration/deceleration is its success in maintaining directional accuracy.
4). According to Theil U six out of seven Swedish CPI-inflation forecasters were not better than the naive alternative for CPI-inflation. Only one Swedish GDP-growth forecaster is outperformed by the naive alternative for GDP-growth. All Swedish forecasters were better than the naive alternative for the unemployment variable. All the Swedish forecasters beat the Theil V naive model.
5).Tests of bias indicates that we underestimate GDP-growth, overestimate both CPI-inflation and unemployment.
6). All the forecasters have been successful in predicting the downward trend in both CPI-inflation and unemployment. NIER could have as well let the current forecast be next years forecast and hence would have better forecasting accuracy. There is need to develop models helping to predict CPI-inflation.
7). Looking at the figures for the GDP-growth forecasts and outcomes it seems that the Swedish forecasters do not capture all the acceleration/deceleration and the cycles under the period of this study 1993-2001. This perhaps is the most important aspect of forecasting.
8). GDP-growth revisions are positively biased.

One would have expected a general improvement in accuracy over time, due to better knowledge of the economy and improved forecast techniques. Unfortunately this seems not to be the case. The results indicate that the forecasters are having problems with both forecasting important macro variables for year ahead forecasts. In addition the acceleration/deceleration was totally missed especially in context of the business cycle. Forecasting implies following the development in the Swedish economy and understanding the sources of fluctuations for central macro economic variables. The sources of the volatility in output, investment and employment is of domestic orgin while most of the fluctuations in export, import, current account, terms of trade and domestic interest rate come from abroad.

In the early 1980 experience there was a broadly synchronized growth slowdown. The breadth of synchronization was surprising in light of the experience with international business business cycle linkages during the 1990s, when recessions occurred with noticeable differences in timing. The international transmission of disturbances will probably will be amplified by the increased financial market interdependence, since many disturbances influence not only demand but also financial market price. The volatility of GDP-growth, CPI-inflation and unemployment has increased substantially as the international business cycle has become more synchronized and there are leads and lags in the business cycles makes forecasting a challenge for forecasters who deal with a small open economy like Sweden.

There is a need to develop econometric models and leading indicators for the Swedish economy which could be a useful tool to aid the forecasters and complementary in providing an alternative to judgmental forecasting for the year ahead forecasts. In addition there is also a need improve the quality of national accounts which is under debate (see Öller and Hansson). There are also tools which can be used to predict booms and recessions like Markov- switching models. These factors outlined above indicate that macroeconomic forecasts leave room for considerable improvements. There is no single method or easy way to improve the quality of forecast. Problems in macroeconomic forecasting: can be due to short time series, data revisions, unreliable data, structural changes and weak inherent predictability (exchange and interest rates). In case the forecasts are generated from a model the forecasting errors can be large due to the (i). Uncertainty about the structure of the model. (ii). Uncertainty about the estimates of the model parameters. (iii) Finally due to the uncertainty about the data caused by revisions and the quality of the national accounts.

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