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by

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Nowcasting Norwegian GDP: The Role of Asset Prices in a Small Open Economy

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Abstract

This paper finds that asset prices on Oslo Stock Exchange is the single most important block of data to improve estimates of current quarter GDP in Norway. Other important blocks of data are labor market data and industrial production indicators. We use an approximate dynamic factor model that is able to handle new information as it is released, thus the marginal impact on mean square nowcasting error can be studied for a large number of variables. We use a panel of 148 non-synchronous variables covering a broad spectrum of the Norwegian economy. The strong impact from financial data is due to an ability of the market clearing process to impart information about the real activity in Norway in a timely manner.

Keywords: Forecasting, financial markets, economic growth, small open economy
JEL Classification: E37, E50, G14

*We gratefully acknowledge contribution from Domenico Giannone for making programs used by Giannone, Reichlin, and Small (2007) available to us. We have received helpful comments from Hilde C. Bjørnland, Michele Modugno, Ragnar Nymoen, Shaun Vahey and from a number of participants at the 2007 Nowcasting Seminar in Norges Bank. Corresponding author: Knut Are Aastveit at k.a.aastveit@econ.uio.no.

1 Introduction

Policy makers rely on indicators that compile information with a time lag and have few sources of contemporaneous information available when the current state of the economy is assessed. One candidate is asset prices. In particular equity prices react continuously to information about the current business climate for companies, as well as about expected future cash flows. In aggregate, an efficient market will reflect the current state of the economy insofar as that has relevance for the value of assets. The market clearing process can be seen as a filtering process for information that is lacking in statistically compiled indicators.

In this paper we use a factor model to assess the current state of the Norwegian economy from a panel of 148 monthly variables. By using a model that builds on Giannone, Reichlin, and Small (2007) (GRS) we are able to assess the marginal impact from various categories of variables. We find that news about equity returns on Oslo Stock Exchange is the category that improves the nowcast the most.

In Beaudry and Portier (2006) it is found that innovations to stock prices are correlated with future productivity growth, i.e., that long term changes in productivity growth are preceded by stock market booms. They argue that the type of model needed to explain these observations is one where agents recognize changes in technological opportunities well before the effect of such changes on productivity is observed. Thus the recognition or expectation itself leads to a boom in consumption and investment, and thus real activity. Jaimovich and Rebelo (2006) and Jaimovich and Rebelo (2007) suggest amendments to the neoclassical model that produce such effects. In the present paper we focus on changes in asset returns as signals about changes in real activity in the same quarter, i.e., there is an almost immediate impact to real activity. The cited papers lends some substance to ascribing such an impact to changes in expectations about the future reflected in asset prices. An additional advantage with asset prices is their timeliness. Relevant news about current business activity is immediately reflected in prices through the market clearing process.

The usefulness of asset prices in predicting real activity has been extensively studied for many countries; Stock and Watson (2003) surveys this large literature. While studies using interest rates, term spreads, and credit spreads abound, a more limited number of studies focus on the equity market. In general, results reported in Stock and Watson (2003) indicates a low predictive content in stock returns. Two more recent studies investigate the predictive power of stock returns in the euro-area. Panopoulou (2006) find that equity returns are helpful in predicting a monthly industrial production index, and it performs better on a one month horizon than longer horizons. While these studies use methods involving single variables, Forni et al. (2003) use a factor model and study the effect of blocks of data on forecasting aggregate real activity (monthly industrial production). They find that financial variables are not important for forecasting real activity even on a one month horizon. Their financial block is however large, and includes several types of financial variables, such as real and nominal interest rates, spreads and exchange rates in addition to stock returns.

This paper differs from these studies in two important ways. First, while the mentioned studies are investigating the forecasting properties of financial assets, we work within a true

nowcasting framework. We study the effect of monthly variables on the concurrent quarterly real growth. Thus we look at the simultaneous relationship between financial variables and the current state of the economy. Second, we use a factor model that can handle non-synchronous data; we can thus in a more precise way than Forni et al. (2003) detect the marginal impact of different variables, at the time they are released.

This paper use the same methodology as Giannone, Reichlin, and Small (2007). They evaluate the marginal impact of different blocks of data in the US economy and find the survey information carries the most information about concurrent GDP growth. They find that financial variables have little impact on the nowcast for the US.

The Norwegian economy is different from the US in obvious ways: It is small, open and a large petroleum exporter. It is reasonable to assume that both terms of trade shocks and other productivity/technology shocks plays a more prominent role in Norway than in a larger, more diversified and less open economy like the US. Moreover it is reasonable to assume that such shocks, say a labor conflict, a change in foreign labor supply or news about a large contract being won by a large company on the exchange, will have an immediate effect on real activity. Hence, we would expect that timely news about such shocks, as reflected in exchange rates and equity returns, are more important than in the US. In line with such an assumption, both GDP growth and returns on the Oslo Stock Exchange are more volatile than similar measures for the US. On the other hand, as petroleum activities are capital intensive and carries substantial fixed costs, it is not surprising that the price of oil and the petroleum related content on the exchange do not have an immediate effect on real activity.

The paper is organized as follows: The following section presents the model. Section three describe in detail the data set and stylized facts about Oslo Stock Exchange. Results are presented in section four. Section five concludes.

2 Model

We assume that the data, X_t, can be described by an approximate dynamic factor model similar to Giannone, Reichlin, and Small (2007). Let

$$X_t = \chi_t + \xi_t = \Lambda F_t + \xi_t \tag{1}$$

where χ_t is a common component driving the variation in X_t and ξ_t is a non-forecastable idiosyncratic component. Λ is a $(n \times r)$ matrix of factor loadings and $F_t = \begin{pmatrix} f_{1t}, & \ldots, & f_{rt} \end{pmatrix}'$ are the factors. Typically the number of factors, r, is much smaller than the number of variables, n, thus securing a parsimonious model. The idiosyncratic component, $\xi_t = \begin{pmatrix} \xi_{1t}, & \ldots, & \xi_{nt} \end{pmatrix}'$, have zero expectation and a covariance matrix equal to $\Psi_t = E\left[\xi_t \xi_t'\right]$.

The factors evolve through time according to the vector autoregression

$$F_t = AF_{t-1} + Bu_t, \tag{2}$$

where A is an $r \times r$ parameter matrix where all roots of $\det(I_r - Az)$ lie outside the unit circle, B is $r \times q$ of full rank q, and q is the number of common shocks in the economy,

i.e., the dimension of u_t. We assume that the common shocks, u_t, follows a white-noise process and that $Q = E\left[Bu_t(Bu_t)'\right]$. In this model an r larger than q captures the lead and lag relations between common factors and common shocks. Equation (1) and (2) together defines a state-space representation of an approximate dynamic factor model. See e.g. Forni et al. (2005a) for details.

In Giannone, Reichlin, and Small (2007), equations (1) and (2) are estimated by a two-step procedure. First parameters are estimated by OLS on principal components from the balanced part of the data set, i.e., the data set up to the last date for which there exists observations of all variables. These parameters and factors are used as initial values in a Kalman-filter re-estimation of the now possibly non-orthogonal factors. Moreover, the unbalanced part of the data set can be incorporated through use of the Kalman-filter. Missing observations are interpreted to have an infinitely large noise to signal ratio. The ability to handle non-synchronized data makes it possible to evaluate the relative importance of blocks of new data releases in real time. The estimator is consistent under general assumptions and feasible for a very large cross section. There are no restrictions on the number of variables, N, relative to number of observations, T. Thus a parsimonious model is obtained. See Giannone, Reichlin, and Small (2007) for details.

Having obtained an estimate of the factors conditioned on all available information up to t, the nowcast is estimated as a simple projection, i.e., quarterly GDP growth is regressed on the factors using OLS.[1] Hence, we assume that the common factors capture the dynamic interaction among the dependent variables as well as the dynamics in GDP. We will return to this issue in Section 4.

The model is re-estimated when the non-synchronous variables in the data set are updated. That is, when new information arrives, the factors are re-estimated and a new OLS is computed for GDP growth as a function of the new factors. The marginal impact of new information is thus immediate in the sense that factors change. However, the marginal impact also have a long-lasting effect because the presence of a variable in the data set affects the covariance structure among all variables and thus the impact of subsequent releases of other variables. For example, the presence of "Financials" early in the month affects the marginal impact of "Production" when those series are released later in the month.

Intuitively, adding a variable, or new observations of an existing variable, may change the allocation of variance in the data set to the common component and to non-forecastable idiosyncratic noise. New observations might bring noise relative to the factor extraction, thus impairing the common component and increasing the importance of idiosyncratic noise. Moreover, the factors are extracted based on the covariance structure between the explanatory variables only, and are not related to covariance with GDP growth at all.

Factor models have long been established as a useful tool in economics, in particular where there is a need to distinguish between noise and valuable information in a large information set. Many authors such as Boivin and Ng (2005), Forni et al. (2005b), Giannone, Reichlin, and Sala (2004) and Stock and Watson (2002) have shown that such models are successful in economic forecasting. The setting in Giannone, Reichlin, and Small (2007) is close to the

[1]Note that in this specification, lagged values of GDP is not included as a predictor.

real life decision making process of a policy maker. This approximate dynamic factor model is able to exploit non-synchronous data releases so that the user can incorporate individual variables as soon as they are released. An alternative framework for real time estimates of GDP growth that also allows non-synchronous data releases is Evans (2005). This model is however not a factor model and only suitable for a limited number of variables.

3 Data

We have collected a large cross section of macroeconomic variables and asset prices for the Norwegian economy. In addition, we use macroeconomic variables and asset prices for Norway's main trading partners; the euro area, Sweden, UK and USA. In total we use a panel of 148 monthly variables. The sample starts in January 1990 and ends in April 2007. All data were collected in May 2007. Series covering financial assets such as equity prices, dividend yields, currency rates, interest rates and commodity prices are constructed as monthly averages of daily observations. All variables are transformed to induce stationarity. The full details of the data set and the transformations are reported in Appendix D.

Following the standard approach, data series that have similar release dates and are similar in content are grouped together in blocks. We have defined a total of 13 different blocks that are released on 7 different dates throughout the months, i.e., on some dates more than one block is released. Number of variables in each block varies from 38 in "Industrial Production" to only two in the "Commodity Prices" block. In Figure 1 we depict how the 13 different blocks are released throughout any month and quarter. Note that data lag has different length for different blocks, ranging from 4 months for the "Labour Market" block to no lag for "Commodity Prices". Thus, the structure of the unbalancedness change when a new block is released.

Most of the blocks contains both aggregated and disaggregated series. The Financials block contain five currency rates and total return and dividend yield for eight different indexes on Oslo Stock exchange, in total 21 variables. There are separate indexes for the total market and for seven different sub-sectors. The indexes are computed and published by Datastream. We refer to Appendix D for a full description of all data series and blocks.

In the following analysis we first run the model with 10 domestic blocks, that is excluding "International Financials", "Mixed International 1" and "Mixed International 2". This is done to focus on data most directly linked to the Norwegian economy. The three international blocks are subsequently included to study the potential effect of international drivers in the Norwegian GDP.

3.1 Ordering of blocks

The ordering of blocks is obvious when the block contains data of monthly frequency with a specific release date. Ordering of blocks with similar release dates does not affect the result. However, financial variables are computed as monthly averages of daily observations and can in principle be included anytime during the month. We make the ad hoc assumption that

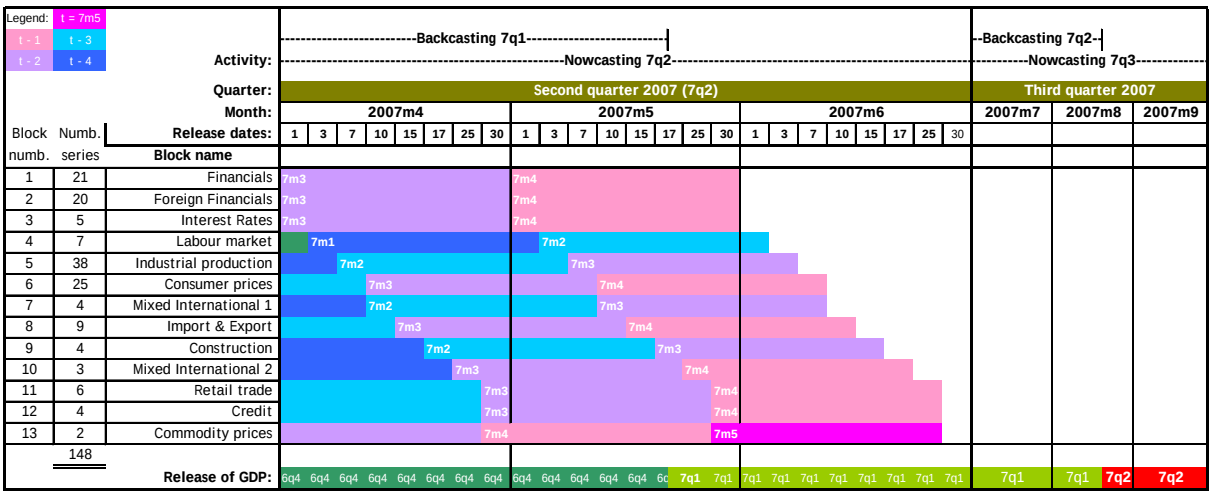

Figure 1: *Structure of data releases during a quarter. The two first months of the second quarter of 2007 is used as an example. All data have monthly frequency. As an example, focus on the Industrial Production (IP) block. The fifth line in the figure shows that new observations become available on the 7th each month and that it is lagging two months when it becomes available, i.e., "t-2" according to the legend in upper left corner. The IP block contains 38 variables. The bottom line depicts the date of the currently available GDP through the quarter.*

these variables become available as monthly averages only once a month. Hence to simplify the block structure in the model we are using less information than possible. In this sense we may understate the importance of the financial variables.

Motivated by the forward looking nature of some financial variables we are letting the blocks "Financials" and "Interest rates" appear as the two first blocks each month. Hence when nowcasting GDP for any given quarter, we use average returns from the last month in the previous quarter, and the two first months of the current quarter. We are not using the last month of the quarter to nowcast the same quarter, as would have been the case if "Financials" where defined as the last block in the month.

For commodities, which to lesser degree can be seen as discounted future cash flows, we let that block arrive as the last one each month.

3.2 How many factors drive the Norwegian economy?

The main strength of factor models is that a huge number of variables can be distilled into a few factors that capture the predictable common component of the data; the residual is non-predictable idiosyncratic noise. A question remains, however, in choosing the appropriate number of factors. This is a model selection problem.

A standard approach to choosing the number of factors is based on the degree of variance in the data set explained by the first r principal components. In Table 3.2 the percentage of

the total variance explained by up to ten principal components is shown:

Number of factors	1	2	3	4	5	6	...	10
10 block model	0.13	0.24	0.31	0.37	0.44	0.50	...	0.67
13 block model	0.16	0.26	0.35	0.41	0.47	0.52	...	0.68

Table 1: *Percentage of total variance explained by the first r static principal components. Based on data from 1990 to 1998.*

We see that a few principal components explain a non-trivial fraction of the total variance in the data set, thus indicating collinearity between the variables.[2] A cut-off for marginal explanation of the next consecutive factor of less than ten percentage points, implies a choice of two factors.

Table 3.2 describe variance of the factors divided by total variance among the dependent variables; it does not relate to the predictive power of the factors relative to GDP growth. Koop and Potter (2004) investigate alternative methods for choosing factors that incorporate the predictive power. They find that the optimal number of factors chosen is on average close to two, underlining the importance of parsimony.

We will in the following parameterize the model with two factors. Our findings are however robust with respect to different choices of number of factors, see Appendix A. [3]

3.3 Oslo Stock Exchange

There are currently 225 listed companies on Oslo Stock Exchange (OSE). By the end of 2006 the total market value was 1915 billion NOK. Measured by earnings before interest, taxes, depreciation and amortization (EBITDA) divided by the national accounts total operating surplus for Norway, the exchange covers about 55 per cent of the real activity in the Norwegian economy[4]. Listed equity in percent of total equity in Norway is less, while market value as a percentage of GDP has increased from 36 percent in 1996 to 89 percent in 2006.

Equities listed in different countries are strongly correlated, indicating the presence of a common international factor in the pricing of equities. Oslo Stock Exchange is no exception, however, a large fraction of the market cap in Oslo is positively exposed to the price of oil. Hence, OSE is more correlated with the price of oil than most other exchanges, and this may explain the somewhat lower correlation with other country indexes. In Figure 2 we see the development in Norwegian as well as main foreign countries' equities since 1990. The figure also show the development of Brent Blend, the crude oil price most relevant for North Sea oil. We see that OSE by and large follows the international pattern, but since 2003 OSE has performed much better coinciding with the strong increase in the price of oil.

[2]We only report the extracted principal components using data up to the end of 1997, since in the first quarter of 1998 we start our out of sample simulations.

[3]More results are available from the authors upon request.

[4]This measure is probably somewhat biased upwards as the operating surplus does not capture real activity in the public sector.

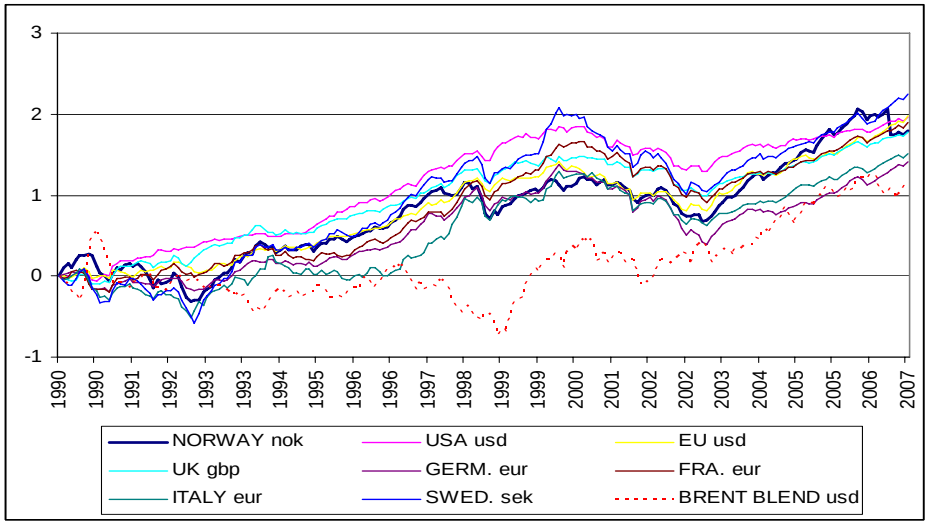

Figure 2: *Development of equity markets. Log of total return indexes, normalized to 1 in 1990. Source: Datastream.*

	NORWAY nok	USA usd	EU usd	UK gbp	GERM. eur	FRA. eur	ITALY eur	SWED. sek
USA	0.46							
EU	0.51	0.75						
UK	0.59	0.77	0.72					
GERMANY	0.58	0.71	0.77	0.73				
FRANCE	0.58	0.73	0.77	0.79	0.88			
ITALY	0.51	0.57	0.62	0.64	0.73	0.74		
SWEDEN	0.63	0.67	0.68	0.69	0.78	0.77	0.68	
BRENT BLEND usd	0.13	-0.19	-0.08	-0.10	-0.14	-0.10	-0.11	-0.10

Legend: -0.2 - 0.0 | 0.0 - 0.4 | 0.4 - 0.6 | 0.6 - 0.8 | 0.8 - 1.0

Figure 3: *Correlations between returns in selected markets. Monthly returns in local currency, 1990 to 2007. Source: Datastream.*

Figure 3 show the correlation structure among the equity indexes that we have included in our data set and to the price of oil. We see that while all other countries in the table is negatively correlated with oil, OSE is weakly positively correlated to the price of oil.

4 Results

4.1 Marginal impact of block releases

We perform a pseudo-real-time out-of-sample simulation. "Real-time" means that all parameters in the model are estimated only on information that where available at the time. "Pseudo" because we do not account for data revisions[5]. Our out-of-sample evaluation be-

[5]Real time data are not available for the data set

gins in first quarter of 1998 and ends last quarter of 2006. As the sample begins first quarter of 1990, the first out of sample evaluation is based on 8 years of data.

We measure performance by mean square error between nowcast and subsequent realization of GDP growth. We chose a naive forecast as benchmark where a constant growth rate, computed on the available history of GDP at the time, is recursively estimated.

In Figure 4 we see how the relative nowcasting error is reduced as new information become available throughout the quarter in the 10-block version of the model. The bars represent the factor model (FM) and the dotted line is our constant growth benchmark, i.e, the naive forecast (RW).

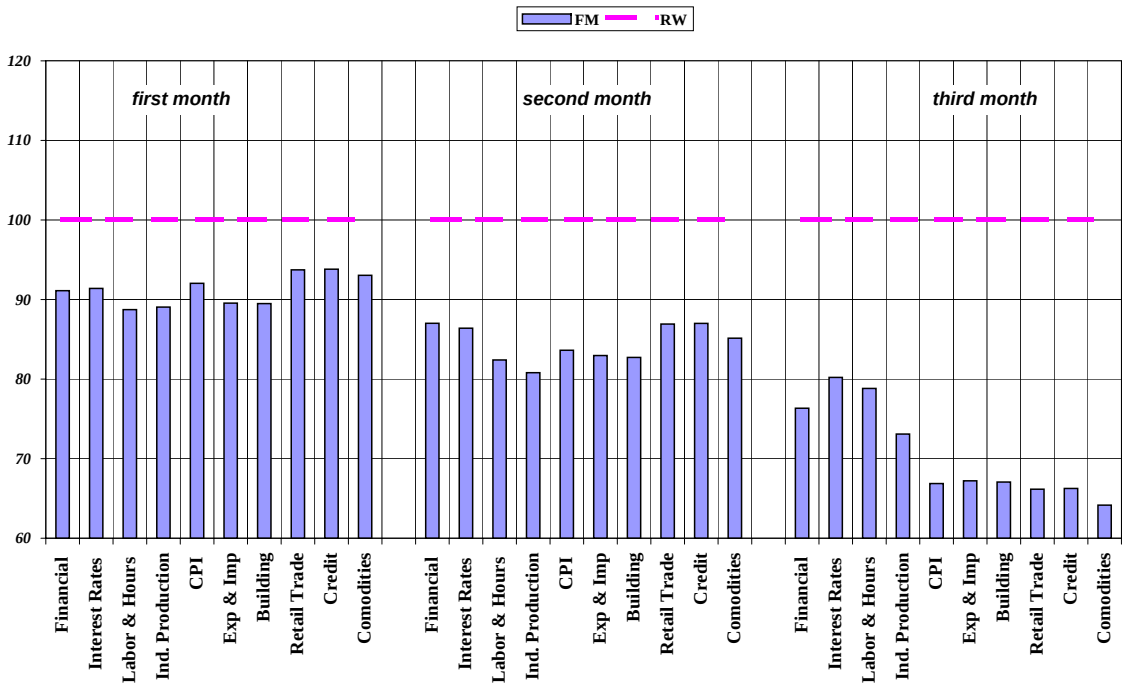

Figure 4: *Marginal change in MSFE as new blocks of data become available; relative to MSFE based on a constant growth rate. Depicting the first, second and third generic month of the quarter for which the nowcast is done. Out of sample nowcasts from 1998q1 to 2006q4. Data sample begins 1990m1.*

We see that towards the end of the generic quarter the nowcasting error of the GRS model is close to 60% of that of the naive nowcast. Furthermore, we see that the performance is steadily improving as new information is incorporated into the model, confirming our intuition that nowcasts of GDP growth by and large will benefit from using newly released information.

A prominent feature of Figure 4 is the large marginal gain when the "Financials" block is released. This effect is large and consistent in all three months of the quarter[6]. The

[6]The large positive effect for the third month is sensitive to whether we order "Financials" as the last

importance of the "Financials" block is confirmed by looking at measures of informational content and by the in-sample marginal effects of blocks, computed over the entire sample, see Appendix B. The "Labour Market" and "Industrial Production" blocks also have positive marginal impacts on the performance of the nowcast.

We also see, however, that some series seem to harm the nowcasting performance. In particular, the CPI block seems to contain more noise than information in the two first months of a quarter, but then become quite informative in the third month. Such changing impact of a block during the quarter may be indicative of a short sample problem. Note however that CPI is released with one month lag around the 10th of each month. Hence only the number released for the two last months relates to inflation within the quarter for which we are nowcasting GDP. One may argue that the last number, covering the middle month, is the most representative for the level of activity in the entire quarter.

In the final step, quarterly GDP growth is regressed on the two factors. Note that we find significant evidence of first order negative autocorrelation in this regression, indicating that the factors do not capture all dynamics in quarterly GDP growth. An alternative specification is to include lagged values of quarterly GDP growth as a dependent variable. This would improve the model's ability to capture dynamics in quarterly GDP growth, however it would make the marginal impact of new information less transparent. The reason can be ascribed to scale. While a new observation of lagged GDP can be quite different from the backcast we need to use in the first part of the quarter, the change in the factors as a result of the release of a new block is on average less dramatic. This difference in scale carries over to the coefficients in the OLS. Hence by including lagged GDP, the unified framework through which to compare information, i.e., the factor model, is lost.[7] As the aim of this paper is prediction (nowcasting) and not hypotheses testing, and since our original estimates are consistent, we decide not to include lagged GDP in the predictive OLS. A more promising approach to include the information in lagged GDP in the nowcast would be some model averaging scheme.

The reported result for asset prices is unique for this study. In particular, Giannone, Reichlin, and Small (2007) do not find similar effects of asset prices using the same methodology on US data. In Giannone, Reichlin, and Small (2007) the marginal impact of "Financials" in the US is negligible. They find that in the US, surveys are the most important type of data in addition to Labour market data. In Norway, surveys are only available on a quarterly frequency and is thus not included in our model. One possibility is that surveys in the US are capturing the information in asset prices and thus makes the financial block redundant.

block of the month or as the first block of the month. It is not obvious, which ordering to choose. However, bearing in mind that financial variables are forward looking variables, we find it reasonable to order them as the first block. The large positive effect for the two first months are not sensitive to this ordering.

[7]In particular the marginal impact of the blocks following a new release of lagged GDP becomes hazardous to interpret. The picture is less robust with respect to the number of factors and less robust to the inclusion/exclusion of different blocks. When the alternative model is run with the model's backcast as an estimate of lagged GDP, and without updating that estimate through the quarter, the results for the marginal effect of the blocks are very similar to results from our chosen model. The overall performance of the nowcast is not affected much by including lagged GDP. See Appendix C for details.

To test for this we have run the GRS model on the same US data as in Giannone, Reichlin, and Small (2007), but without surveys. We find that this does not improve the marginal impact from "Financials".

In general, although intuitively one should think that asset prices would contain information about the macro economy, such results have been empirically elusive. Thus, there is reason to ask whether there are special features of the Norwegian economy that can explain the affirmative results reported here.

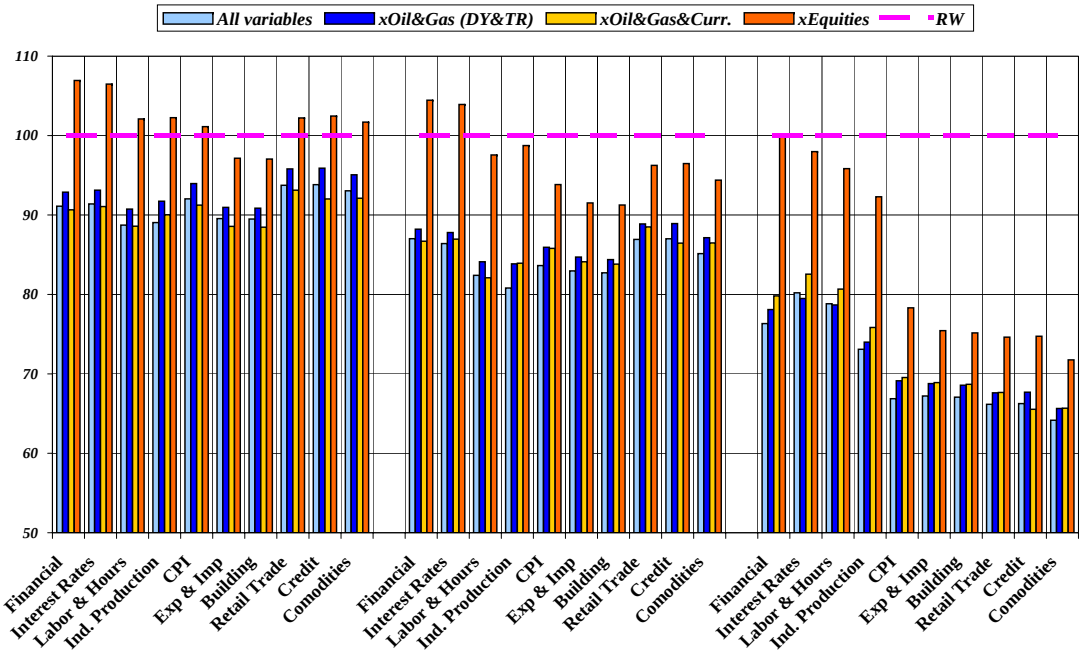

Figure 5: *Marginal change in relative MSFE. Excluding selected variables in the Financials block, bars from left to right: All variables, excluding Market index and Oil & Gas sector both among total return series and among dividend yield series, excluding currencies as well, excluding all equities. Depicting the first, second and third generic month of the quarter for which the nowcast is done. Out of sample nowcasts from 1998q1 to 2006q4. Data sample begins 1990m1.*

4.2 Why do equities matter in Norway?

The Norwegian economy is characterized by being small, open and dependent on natural resources like oil. One conjecture is therefore that because of the openness and the small size, Norway experiences more and more significant shocks to productivity than what the US does. Smaller size could mean that the economy is less diversified and that e.g. a technology shock will have a larger impact on the aggregate economy. Examples could be a sudden change in availability of foreign labour, unexpected domestic labour market frictions, news

about a large contract being won by one of Norway's few large companies, etc. The effect in real activity could be rather immediate for such shocks, hence the lags in macroeconomic statistics could be an important reason why equities are more informative for nowcasting. An observation in line with this conjecture is that both volatility on Oslo Stock Exchange and the volatility of Norwegian GDP is larger than for most other countries.

In a recent study, Beaudry and Portier (2006) shows that a shock to stock prices are strongly colinear with anticipated productivity shocks leading to a delayed but permanent change in productivity. Their results indicate that most of the productivity shocks are anticipated by the stock market long before it is materialized. In other words, shocks that affect future productivity will be immediately captured by the pricing in the stock market.

To check which variables within the "Financials" block are particularly important, we run the model with selected variables excluded. In Figure 5 we can see the effect of excluding the currencies or all equity variables respectively. The third bars is the result when currencies are excluded. We see that results are not much effect by removing currencies from the financial block. The last bars is the result when only currencies are left in the "Financials" block. Here we see that results deteriorate more, and across the entire quarter. Thus we find that while currencies are not very important, data from Oslo Stock Exchange is much more relevant.

In Figure 6 we illustrate the effect of total return information versus dividend yield information. We see that while dividend yield has best performance in the beginning of the quarter, total return carry more information when used towards the end of the quarter. Both sets of variables contribute to the performance of the nowcast.

Given that Oslo Stock Exchange is characterized by relatively high correlation to the price of oil and also quite high correlation to the international stock market, it is of interest to check whether the high marginal nowcasting performance of the equity returns is a proxy for either an oil price factor or for an international factor.

With a view to the low informational content of the "Commodity Prices" block, it would be surprising if the good nowcasting performance of the Financials block were due to the high correlation between returns on OSE and the price of oil. To check for this we remove both the total market index for OSE and the sector index covering the oil and gas industry on OSE, both for total return and dividend yield. We remove the total market index because of its high weight to the oil and gas sector. The result is shown in the second bars from the left in Figure 5. They are almost the same as the original result, confirming the low informational content for the "Commodity Prices" block. As petroleum activities are capital intensive and carries substantial fixed costs, it is not surprising that the price of oil and the petroleum related content on the exchange do not have an immediate effect on real activity.

Turning to test for an international equity effect, in Figure 7 we have included international equity data in block number 2, covering seven main trading partners to Norway. International interest rates are not included. This inclusion has a strong negative impact on the performance, hence pricing of equities abroad represents noise relative to the nowcast. The strong performance of Norwegian equities are thus not a proxy for an international equity factor. Intuitively one would expect international equities to have more impact on a

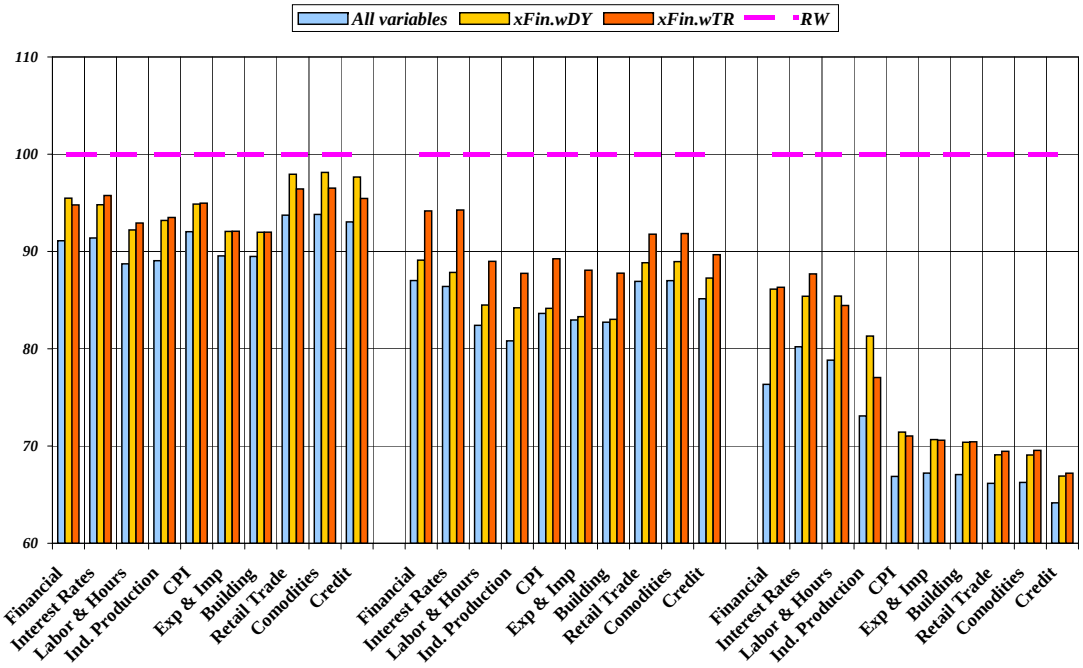

Figure 6: *Marginal change in relative MSFE. The difference between dividend yield data and total return data from Oslo Stock Exchange. Bars from left to right: All variables, excluding total return, excluding dividend yield. Depicting the first, second and third generic month of the quarter for which the nowcast is done. Out of sample nowcasts from 1998q1 to 2006q4. Data sample begins 1990m1.*

forecast than on a nowcast; pricing of news abroad bear little immediate impact on current activity in Norway.

Lastly we include all 13 blocks In Figure 8; here International financials contain both interest rates and equity data, and two mixed international blocks contain various macro series, see the appendix for details. Clearly the result is again substantially worsened when both international equity data and international macro are included.

Keeping in mind that we are nowcasting current quarter GDP growth, this result is not surprising. While an open economy clearly is influenced by real activity in other countries, one would expect international changes to filter into Norwegian real activity with a lag. Figure 8 indicates that the lag is longer than one month. This result for the 13-block model is also robust to the number of factors.

Even though including more information improves the factors in terms of explanatory power among the independent variables, see Table 3.2, it worsens the predictive power of the factor, indicating that the increased variability is not related to GDP growth. Hence, in this model more information is not always a good; it may destroy some of the structure in the existing information and thus harm the predictive power of the model. See Boivin and Ng (2006) for further discussion.

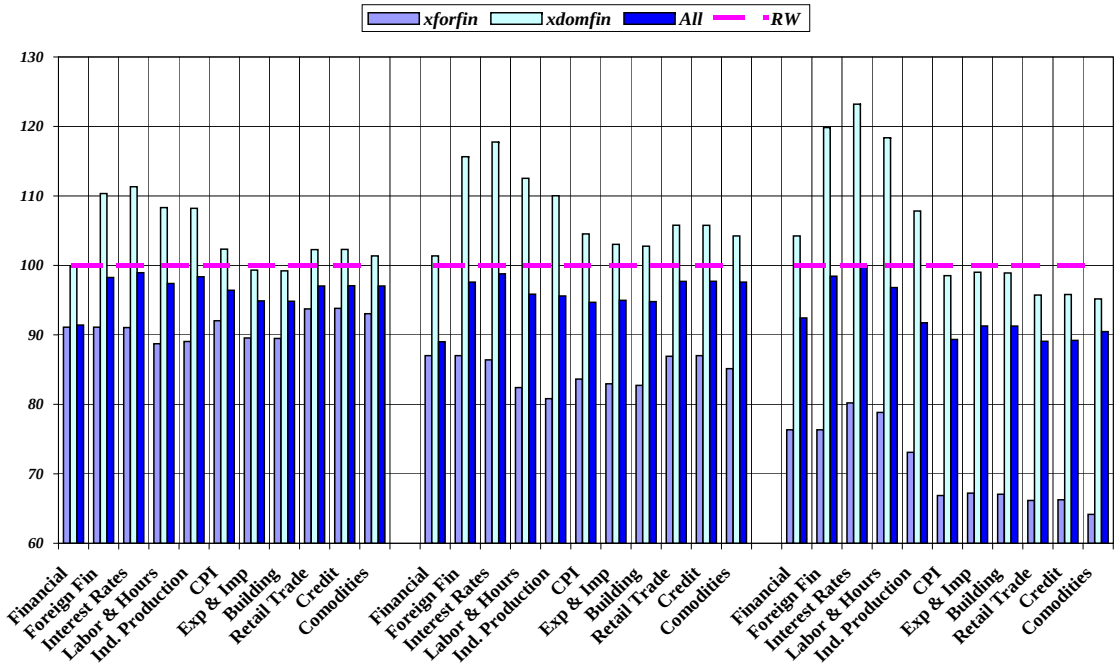

Figure 7: *Effect of foreign financials. Bars from left to right: All domestic variables, including foreign financials and excluding domestic financials, including both domestic and foreign financials. Depicting the first, second and third generic month of the quarter for which the nowcast is done. Out of sample nowcasts from 1998q1 to 2006q4. Data sample begins 1990m1.*

5 Summary and conclusion

In this paper we have used an approximate dynamic factor model on Norway to study the marginal impact on a nowcast of current quarter GDP growth from new data releases. We have found that financial data contributes the most to the precision of the nowcast, in particular data from Oslo Stock Exchange. Hence financial data provide a valuable contribution in addition to statistically compiled indicators. We find that in particular labor market data and industrial production indicators also contribute favorably to the precision of the nowcast.

The Oslo Stock Exchange is highly correlated with international equity markets. However, when we include international financials, or substitute Norwegian financials with international financials, the precision of the nowcast deteriorate. The exchange in Norway has a high content in petroleum related equities, but this is not driving the performance of equity returns either. We thus conclude that the nowcasting performance of Oslo Stock Exchange is related to the market clearing process imparting information about real activity in Norway.

Results also deteriorate sharply when international macro variables are included in the data set. Although Norway is an open economy this is not surprising as international conditions supposedly have an effect on activity in Norway with a time lag. Even though including

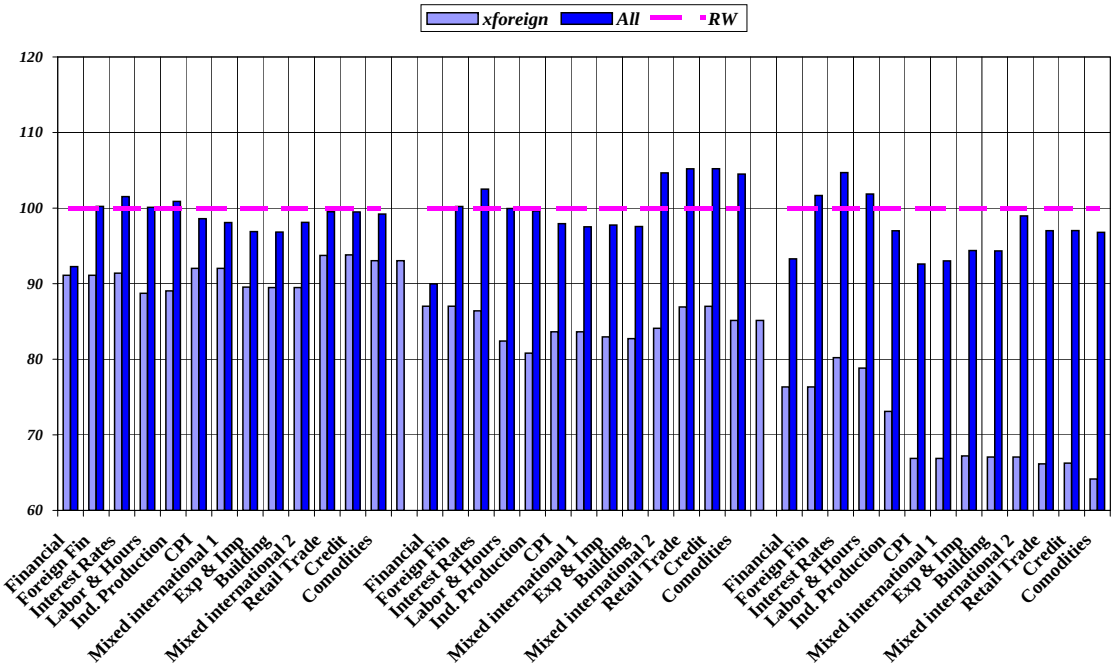

Figure 8: *Including the three international blocks. Bars from left to right: All domestic variables (no international blocks), including foreign financials and international macro data. Depicting the first, second and third generic month of the quarter for which the nowcast is done. Out of sample nowcasts from 1998q1 to 2006q4. Data sample begins 1990m1..*

international data bring about factors that explain more of the variance among the independent variables, this increased variance in the factors are of a nature that has low correlation to the current quarter GDP growth in Norway, thus reducing the predictive power of the factors.

A model establishing a link between financial variables and the current state of the economy is valuable from the point of view of the policy maker. The link presented here provides access to timely information from financial markets and a means to combine such information with a larger set of indicators. The strong results in the present paper motivates further studies. In particular, to further identify why equity returns matter in Norway, more detailed information about the cross section on Oslo Stock Exchange would be valuable. We find that the seven sector indexes that is included in the data all are close to equally important. However, other features of companies than industry have not been investigated. In Vassalou (2003) the connection between Fama-French factors and news about GDP growth is studied for the US. She finds that the Fama-French factors seem to be proxies for news related to GDP growth. We relegate this topic to further studies.

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A Robustness to the number of factors

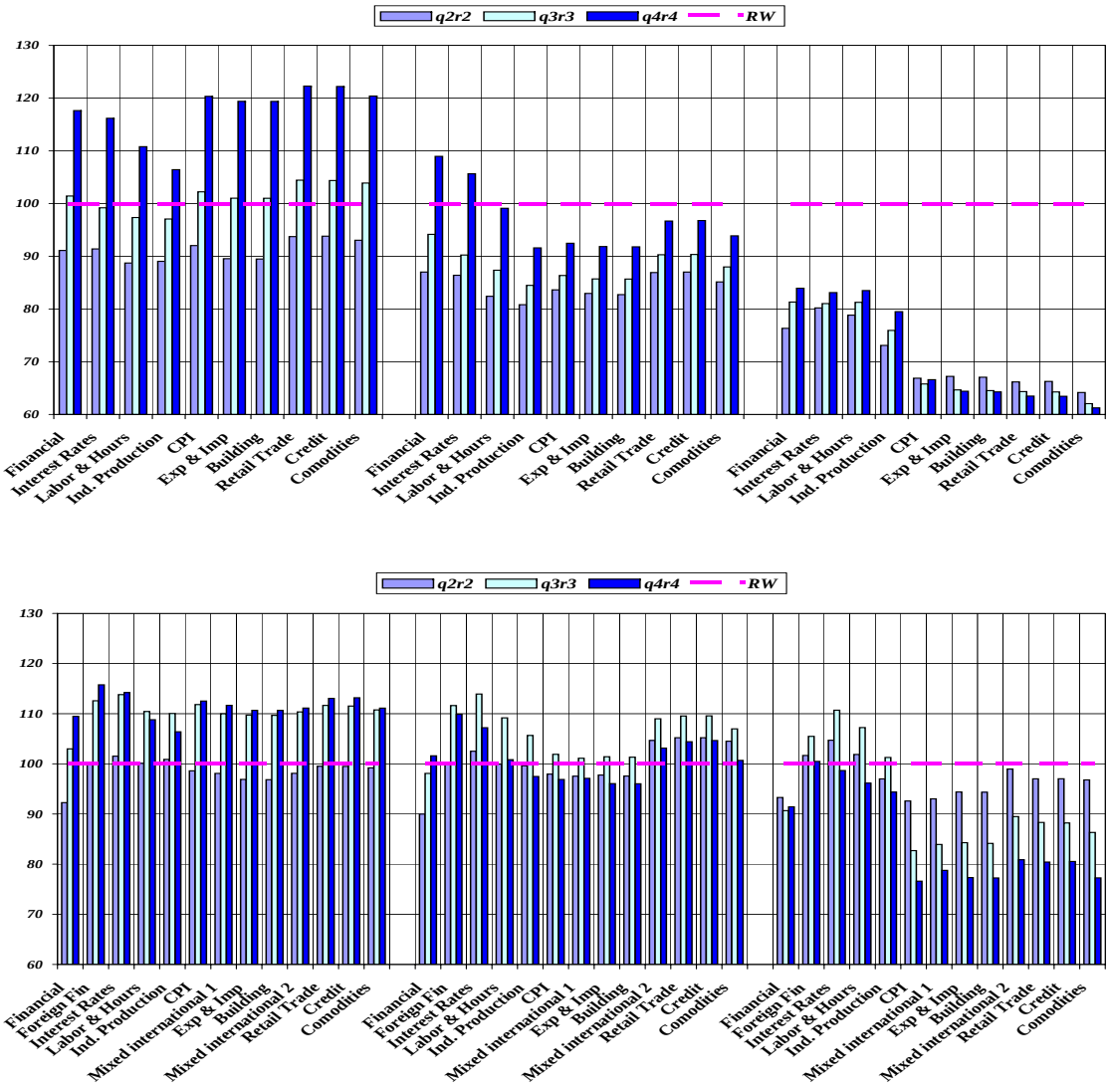

Figure 9: *Nowcasting performance using different number of factors. Upper panel describes the 10 block variant of the model. Lower panel contains the full 13 blocks.*

B Importance of financials

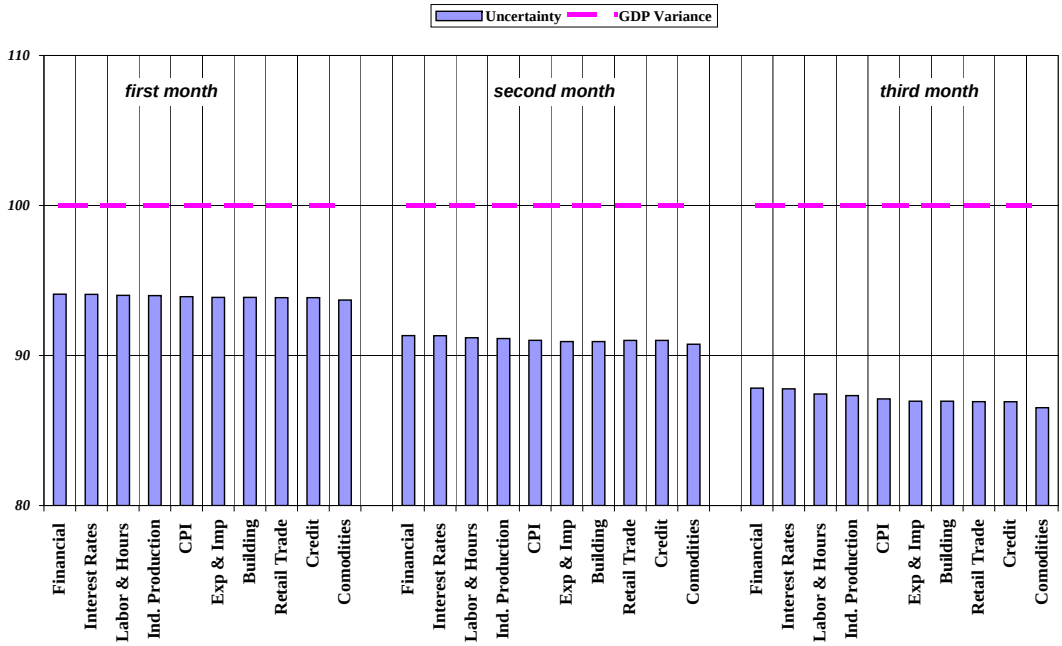

Figure 10: *The model based, in-sample nowcast accuracy, i.e., the variance of the factor as measured in the Kalman Filter. This variance is plotted relative to the variance of GDP.*

C Effects of including lagged GDP as predictor

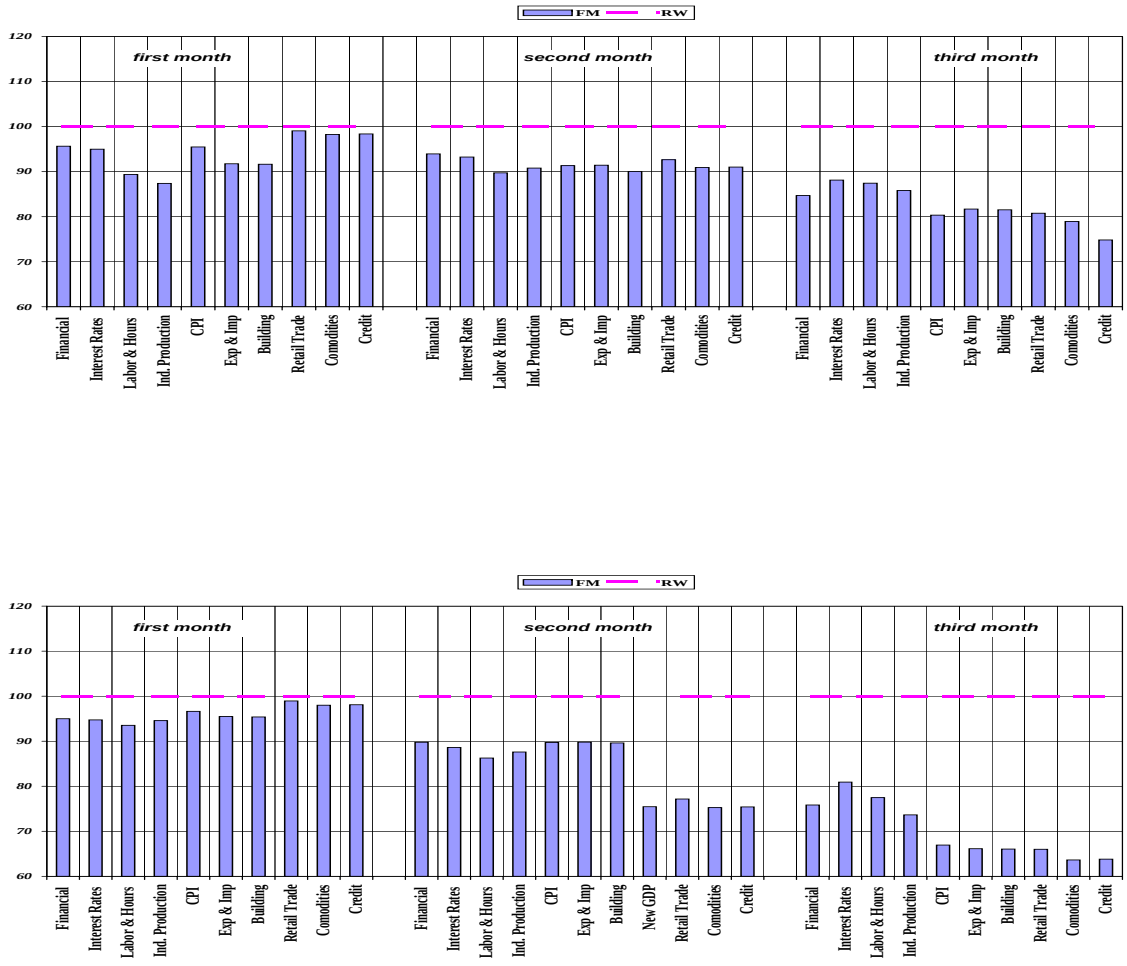

Figure 11: *Nowcasting performance when including lagged value of GDP as predictor. Upper panel describes variant using an estimate for lagged value of GDP as predictor. Lower panel describes variant where we update with the actual value of lagged GDP after it is released.*

D Full description of the data set

We apply the following transformations to the raw data in order to induce stationarity. 2 = First differences, 3 = First differences in logs, 4 = Differences of first differences in logs. Below is a complete description of the data set:

#	Database	Block	Description	Transformation
1	normap	Labour Market	Unemployed persons registered at the Emmployment Office in percent	2
2	normap	Labour Market	Vacancies, stock	3
3	normap	Labour Market	Total unemployed and participants in labour market schemes	3
4	normap	Labour Market	Total temporary unemployed. (Break in series from 1.1.2003.)	3
5	normap	Labour Market	Participants in labour market schemes	3
6	normap	Consumer Price Index	Food (without alcohol) Ses.adjust.1998=100	3
7	normap	Consumer Price Index	Alcohol & tobacco. Ses.adjust. 1998=100	3
8	normap	Consumer Price Index	Apparel Ses.adjust. 1998=100	3
9	normap	Consumer Price Index	Housing Ses.adjust. 1998=100	3
10	normap	Consumer Price Index	Furniture and Houshold article Ses.adjust. 1998=100	3
11	normap	Consumer Price Index	Health care Ses.adjust. 1998=100	3
12	normap	Consumer Price Index	Transportation Ses.adjust. 1998=100	3
13	normap	Consumer Price Index	Post- og tele services. Ses.adjust. 1998=100	3
14	normap	Consumer Price Index	Culture and Leisure. Ses.adjust. 1998=100	3
15	normap	Consumer Price Index	Hotel- and restaurant services. Ses.adjust. 1998=100	3
16	normap	Consumer Price Index	Other commodities and services. Ses.adjust. 1998=100	3
17	normap	Consumer Price Index	Other Norwegian produced consumer goods. Ses.adjust.	3
18	normap	Consumer Price Index	Other services Ses.adjust.	3
19	normap	Consumer Price Index	Other services with salary as dominated price factor. Ses.adjust.	3
20	normap	Consumer Price Index	Other services including also other important price factors. Ses.adjust	3
21	normap	Consumer Price Index	Fish products Ses.just.	3
22	normap	Consumer Price Index	Rent (housing) Ses.adjust.	3
23	normap	Consumer Price Index	Imported consumer goods	3
24	normap	Consumer Price Index	Imported consumer goods with Norwegian competition	3
25	normap	Consumer Price Index	Imported consumer goods without Norwegian competition	3
26	normap	Consumer Price Index	Agriculture goods.	3
27	normap	Consumer Price Index	Other Norwegian produced consumer goods, (almost) not influenced by world maket price.	3
28	normap	Consumer Price Index	Affected by world market due to competition from abroad	3
29	normap	Consumer Price Index	Affected by world market because of large import share or raw material price determined by world market	3
30	normap	Consumer Price Index	Total	3
31	normap	Exports & Imports	Export fish and fish products. Mill. nok	3
32	normap	Exports & Imports	Export forest products. Mill. nok	3
33	normap	Exports & Imports	Export Aluminum and -alloys. Mill. nok	3
34	normap	Exports & Imports	Exports of natural gas, value	3
35	normap	Exports & Imports	Exports of crude oil, natural gas and condensates, value	3

#	Database	Block	Description	Transformation
36	normap	Exports & Imports	Exports excl. ships and oil platforms, value	3
37	normap	Exports & Imports	Exports excl. ships, oil platforms, crude oil, natural gas and condensates, value	3
38	normap	Exports & Imports	Imports excl. ships and oil platforms, value (in millions)	3
39	normap	Exports & Imports	Imports excl. ships, oil platforms and crude oil, value (in millions)	3
40	normap	Building	Number of homes initiated building. Ses.adjust.	3
41	normap	Building	Homes initiated building, aerea. Ses.adjust.	3
42	normap	Building	Number of commercial buildings initiated building	3
43	normap	Building	All buildings initiated. Area in squeare meters.	3
44	normap	Indutstrial Production	Intermediate goods	3
45	normap	Indutstrial Production	Capital goods	3
46	normap	Indutstrial Production	Durable consumer goods	3
47	normap	Indutstrial Production	Non-durable consumer goods	3
48	normap	Indutstrial Production	Consumer goods, total	3
49	normap	Indutstrial Production	Energy goods	3
50	normap	Indutstrial Production	Total	3
51	normap	Indutstrial Production	Oil and gas extraction	3
52	normap	Indutstrial Production	Pulp, paper and paper products	3
53	normap	Indutstrial Production	Publishing, printing, reproduction	3
54	normap	Indutstrial Production	Basic chemicals	3
55	normap	Indutstrial Production	Metals, ses.adjust.	3
56	normap	Indutstrial Production	Metal products, without machines and equipment	3
57	normap	Indutstrial Production	Mining, quarrying and extraction	3
58	normap	Indutstrial Production	Mining energy related. Ses.adjust.	3
59	normap	Indutstrial Production	Mining and quarrying	3
60	normap	Indutstrial Production	Other mining and quarrying	3
61	normap	Indutstrial Production	Manufacturing, mining and quarrying	3
62	normap	Indutstrial Production	Manufacturing	3
63	normap	Indutstrial Production	Food products, beverages, tobacco	3
64	normap	Indutstrial Production	Food products	3
65	normap	Indutstrial Production	Prod. av tekstil-og bekledningsvarer	3
66	normap	Indutstrial Production	Textiles, wearing apparel, leather	3
67	normap	Indutstrial Production	Preparation of textiles, wearing apparel, leather	3
68	normap	Indutstrial Production	Wood and wood products except furniture	3
69	normap	Indutstrial Production	Pulp, paper and paper products and publishing, printing, reproduction	3
70	normap	Indutstrial Production	Production of chemials and -products	3

#	Database	Block	Description	Transformation
71	normap	Indutstrial Production	Rubber and plastic products	3
72	normap	Indutstrial Production	Other non-metallic mineral products	3
73	normap	Indutstrial Production	Metals and metal products.	3
74	normap	Indutstrial Production	Machinery and equipment n.e.c.	3
75	normap	Indutstrial Production	Electrical and optical equipment	3
76	normap	Indutstrial Production	Transport equipment and oil plattforms	3
77	normap	Indutstrial Production	Transport equipment	3
78	normap	Indutstrial Production	Oil plattforms	3
79	normap	Indutstrial Production	Other industrial production	3
80	normap	Indutstrial Production	Power and water supply	3
81	normap	Indutstrial Production	Oil refineries and chemical inustrial production	3
82	normap	Retail Trade	Retail trade total	3
83	normap	Retail Trade	Retail sale in non-specialized stores	3
84	normap	Retail Trade	Retail sale in non-specialized stores with food, beverages and tobacco predominating	3
85	normap	Retail Trade	Other retail sale in non-specialized stores	3
86	normap	Retail Trade	Retail sale of food, beverages and tobacco in specialized stores	3
87	normap	Retail Trade	Wholesale trade, total	3
88	datastream	Commodities	LME-Aluminium99.7% Cash U$/MT - A.M. OFFICIAL	3
89	datastream	Commodities	Crude Oil-BrentCur. Month FOB U$/BBL	3
90	datastream	Interest rates	NORWAY INTERBANK 3 MONTH - OFFERED RATE	2
91	datastream	Interest rates	NORWAY INTERBANK 6 MONTH - OFFERED RATE	2
92	datastream	Interest rates	NORWAY INTERBANK 1 YEAR - OFFERED RATE	2
93	datastream	Interest rates	NORWAY BENCHMARK 5 YEAR - MIDDLE RATE	2
94	datastream	Interest rates	NORWAY BENCHMARK 10 YEAR - MIDDLE RATE	2
95	troll8	Financials	Exchange rate NOK/USD, spot	3
96	troll8	Financials	Exchange rate NOK/EUR, spot	3
97	troll8	Financials	Trade-weighted exchange rate (TWI)	3
98	troll8	Financials	Exchange rate NOK/GBP, spot	3
99	troll8	Financials	Exchange rate NOK/SEK, spot	3
100	troll8	Financials	Nominal effective import-weighted krone exchange rate (I44)	3
101	datastream	Financials	NORWAY-DS Market - TOT RETURN IND	3
102	datastream	Financials	NORWAY-DS Oil & Gas - TOT RETURN IND	3
103	datastream	Financials	NORWAY-DS Basic Mats - TOT RETURN IND	3
104	datastream	Financials	NORWAY-DS Industrials - TOT RETURN IND	3
105	datastream	Financials	NORWAY-DS Consumer Svs - TOT RETURN IND	3

#	Database	Block	Description	Transformation
106	datastream	Financials	NORWAY-DS Utilities - TOT RETURN IND	3
107	datastream	Financials	NORWAY-DS Financials - TOT RETURN IND	3
108	datastream	Financials	NORWAY-DS Technology - TOT RETURN IND	3
109	datastream	Financials	NORWAY-DS Market - DIVIDEND YIELD	2
110	datastream	Financials	NORWAY-DS Oil & Gas - DIVIDEND YIELD	2
111	datastream	Financials	NORWAY-DS Basic Mats - DIVIDEND YIELD	2
112	datastream	Financials	NORWAY-DS Industrials - DIVIDEND YIELD	2
113	datastream	Financials	NORWAY-DS Consumer Svs - DIVIDEND YIELD	2
114	datastream	Financials	NORWAY-DS Utilities - DIVIDEND YIELD	2
115	datastream	Financials	NORWAY-DS Financials - DIVIDEND YIELD	2
116	LFS	Labour Market	Employment, Persons	3
117	LFS	Labour Market	Employment, Hours	3
118	Norges Bank	Credit	Credit (C1) to general public	4
119	Norges Bank	Credit	Credit (C2) to non-financial enterprises	4
120	Norges Bank	Credit	Credit (C2) to households	4
121	Norges Bank	Credit	Credit (C2) to general public	4
122	EconWin	Mixed International 1	United States, Production, Manufacturing, Overall, Total (SIC), Constant Prices, SA, Index, USD	3
123	EconWin	Mixed International 1	Sweden, Production, By Industry, Manufacturing, Overall, D, Total, Cal Adj, SA, Index, SEK	3
124	EconWin	Mixed International 1	Eurostat, Euro Zone, Production, Manufacturing, Overall, D, Total, SA, Index, EUR	3
125	EconWin	Foreign Financials	United States, Government Benchmarks, Bid, 10 Year, Yield, End of Period, USD	2
126	EconWin	Foreign Financials	Sweden, Government Benchmarks, Bid, 10 Year, Yield, End of Period, SEK	2
127	EconWin	Foreign Financials	Euro Zone, Government Benchmarks, Bid, 10 Year, Yield, Average, EUR	2
128	EconWin	Foreign Financials	United States, Interbank Rates, BBA LIBOR, 3 Month, Fixing, USD	2
129	EconWin	Foreign Financials	Sweden, Interbank Rates, STIBOR, 3 Month, Fixing, SEK	2
130	EconWin	Foreign Financials	Euro Zone, Interbank Rates, BBA LIBOR, 3 Month, Fixing, EUR	2
131	EconWin	Mixed International 1	United States, Consumer Prices, All items, SA, Index, USD	3
132	EconWin	Mixed International 1	Sweden, Consumer Prices, By Commodity, All Items, Total, Index, SEK	3
133	Internet	Mixed International 2	Chicago Fed Midwest Manufacturing Survey, general activity	2
134	Internet	Mixed International 2	US Consumer Confidence Index	2
135	Datastream	Foreign Financials	US-DS Market - TOT RETURN IND	3
136	Datastream	Foreign Financials	EU-DS Market - TOT RETURN IND	3
137	Datastream	Foreign Financials	UK-DS Market - TOT RETURN IND	3
138	Datastream	Foreign Financials	GERMANY-DS Market - TOT RETURN IND	3
139	Datastream	Foreign Financials	FRANCE-DS Market - TOT RETURN IND	3
140	Datastream	Foreign Financials	ITALY-DS Market - TOT RETURN IND	3

#	Database	Block	Description	Transformation
141	Datastream	Foreign Financials	SWEDEN-DS Market - TOT RETURN IND	3
142	Datastream	Foreign Financials	US-DS Market - DIVIDEND YIELD	2
143	Datastream	Foreign Financials	EU-DS Market - DIVIDEND YIELD	2
144	Datastream	Foreign Financials	UK-DS Market - DIVIDEND YIELD	2
145	Datastream	Foreign Financials	GERMANY-DS Market - DIVIDEND YIELD	2
146	Datastream	Foreign Financials	FRANCE-DS Market - DIVIDEND YIELD	2
147	Datastream	Foreign Financials	ITALY-DS Market - DIVIDEND YIELD	2
148	Datastream	Foreign Financials	SWEDEN-DS Market - DIVIDEND YIELD	2
149		GDP	Quarterly GDP growth	7

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