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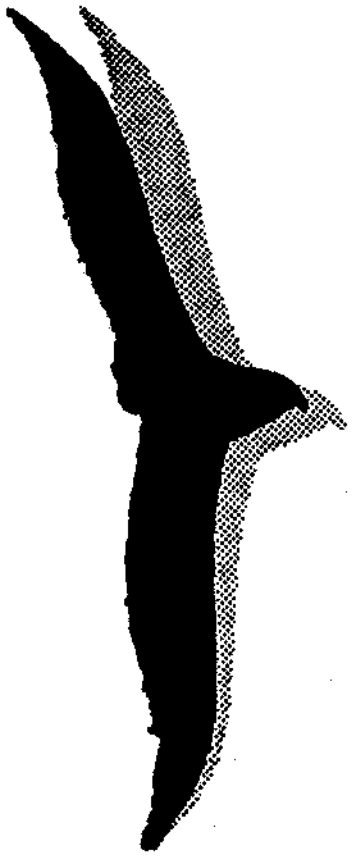

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THE ART AND SCIENCE OF MACROECONOMIC FORECASTING, AND THE DUTCH EXPERIENCE

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By F.A.G. den Butter*

1. Introduction

The crystal ball is not only an indispensable instrument for the initiated crystal gazer to reveal esoteric knowledge about the future. It is also a neat symbol for macro-economic forecasting. In this metaphor the crystal ball represents the model or, more in general, the prediction method that the economic forecaster uses for shaping his (or her) view on the economic future. Up to date econometric methodology and/or economic theory may be applied for constructing the prediction method which is most suitable for the forecasting purposes.

However, the crystal ball only mirrors and colours reality according to its special shape and polishing, whereas it is the crystal gazer who has to interpret these mirror images so as to verbalize them to events which are likely to happen. In the same way the economic forecaster has to interpret the results that come out of the prediction method ("the computer"), and should add his own judgement before making the forecasts public. Interpretation and judgement mark the difference between the art and the science of economic forecasting.

This paper discusses some aspects of forecasting for macro-economic policy purposes. The next section is on the science of forecasting. It shortly surveys the scientific methods available to the forecaster and considers their merits. Section 3 is on the art of forecasting. Whereas section 2 tells what toolbox the forecaster has for the construction of his crystal ball, section 3 looks at the required skill of the forecaster to use this forecasting device. Economic forecasts will never become (completely) true. Therefore, section 4 shows how we can evaluate the performance of various forecasters and their models, and how we can learn from the prediction errors. Section 5 summarizes the experience in the Netherlands with macroeconomic forecasting and model-based policy analysis. Finally section 6 concludes with a number of assertions on macroeconomic forecasting which may seem somewhat alluring for those not familiar with the art of forecasting.

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Macroeconomic development is, to a certain extent, unpredictable. An essential feature of objective economic forecasting methods is that they are designed to deal with limited predictive ability and that they try to separate as good as possible the signal from the noise in the information contained in economic time series. Moreover, in economic life the near future is usually more easily predictable than the far away future. Technically speaking, the signal to noise ratio becomes smaller the more periods are to be predicted ahead. My experience is that in mechanical dynamic time series models the signal to noise ratio rapidly goes to zero when the number of periods to be predicted ahead increases. Hence, for long term forecasting these models boil down to very naive extrapolation models, such as no change. In that case the variance of the prediction error is as large as the variance of the series itself.

A difference between mechanical forecasting methods and causal economic models is that the causal models require future values of exogenous variables as an input. Because generating input values can be mechanized by use of extrapolative formulas for the exogenous variables, the causal models can be used as a mechanical method as well. There is no essential difference between both methods in this respect.

The crucial difference, however, is that causal methods are very helpful for the art of forecasting, while mechanical methods are not, or only very little. In this respect I believe that, whenever there is room for improvement in macroeconomic forecasting, it will come through improving the art of forecasting. Therefore the development of the science of forecasting should be such that it supports the art of forecasting in the best possible way. That's why the scope for improving our forecasting performance in macroeconomics is rather limited when we concentrate on the development of more sophisticated mechanical methods only. Especially the marginal productivity of new and sophisticated estimation methods with respect to predictive performance of time series models seems very low. The improvement of model selection methods and specification tests will not add much to the predictive performance of these models either. A better economic theory can be instrumental to enlarge our understanding of the future and is essential for the art of forecasting. However, when better model specifications due to sophisticated economic theory are merely used for the production of mechanical forecasts, the gain in predictive accuracy will again be small.

A proper disaggregation of time series models can be useful in case the models for the disaggregate series are more stable and have a higher signal to noise ratio than the model for the aggregated series. Yet, I do not know many practical examples that show a considerable gain in predictive performance due to disaggregation. In my view the most promising approach for scientific help to the art of forecasting is the methodology of combining forecasts. This procedure defies the notion of many old-fashioned technocrats that there exists one superior forecasting model with accompanying estimation method. The combination methodology allows different forecasting models to coexist as these models may contain different information useful to the forecast. Bates and Granger (1969) prove that, when two forecasts contain different information, and hence when one forecasting method does not encompass the other one, a combination of both forecasts will always yield better predictions than one of the two forecasts separately. Combining forecasts enables to

forecast of national income. Moreover he should be aware of the fact that in a simultaneous equation structural economic model add-factoring of one equation will affect the outcomes of all other endogenous variables.

This brings us to the main rationale for the use of a forecasting model: it makes the forecasts consistent and it makes the assumptions in the forecasting-process explicit. The size of the add-factors should be plausible. In this respect it is helpful to compute the add-factors that equate the dynamic model-simulations over the recent past to their realizations. These endogenously determined add-factors indicate how big the add-factors should have been in the recent past in order to get a perfect prediction.

If skilfully applied the mechanical forecasting methods can have their own role in this art of forecasting. For instance, short term mechanical predictions may provide benchmarks for add-factors (see Corrado and Greene, 1988). Mechanical methods are also useful for extrapolating those exogenous variables which, because of their sheer number or for other reasons, cannot be determined by judgement.

Some international institutions (such as OECD, IMF, World Bank, EC) and commercial companies (DRI, Wharton) are specialized in making a consistent forecast of the world economy. It is obvious that the forecasting of so many interdependent macroeconomic variables is an iterative procedure and involves a number of people who are well trained in the art of forecasting. It also requires a good organisation of the forecasting process. As an example of such a professional forecasting exercise we consider the OECD-procedure for the forecasts published in the *Economic Outlook*. This example is selected because it is well documented (see Llewellyn, Samuelson and Porter, 1985, chapter 10). The procedure can be summarized as follows:

- The Economic Outlook is a semi-annual publication and contains forecasts for the world over the period of the next one and a half year
- The forecasting procedure is centred around the Secretariat's world model INTERLINK
- Apart from a small central group responsible for maintaining the model and for organising the regular forecasting round, OECD forecasts are made by a number of country and subject specialists which each devote only a part of their time to that activity
- Therefore the forecasting round should be well organised and has a fixed time table with the following stages:

Stage 1. First climate run

- review of recent data
- updated set of add-factor adjustments
- new exogenous variables, mainly newly announced policy measures
- this first climate run is merely a mechanical update of the previous set of forecasts
- the results of the first climate run are circulated only to those actively participating in the construction of the projections

best methods known at that time. This was a scientific fact, but a *sad* scientific fact. For Slichter could not and did not pass on his art to an assistant or to a new generation of economists. It died with him, if indeed it did not slightly predecease him. What he hoped to get by scientific breakthrough is a way of substituting for men of genius, men of talent and even just run-of-the-mill men. That is the sense in which science is public, reproducible knowledge."

Hence Samuelson's main concern with forecasting is that a forecasting artist may outperform a forecasting scientist, while the art of forecasting is non-reproducible.

Macroeconomic forecasting is certainly not the only and probably not even the main reason for building macroeconomic models. Policy analysis also uses these models for *scenario analysis* and for *policy simulations*. Scenario analysis is very closely connected with macroeconomic forecasting. A scenario is a model-based projection of the future under specific assumptions on exogenous variables, especially policy variables. The main rationale for this type of analysis is to show what will happen in case specific policy measures are taken. Or, more dramatically, "pessimistic" scenarios may show, for instance in the case of environmental policy, what will happen if policy measures are not taken.

As a matter of fact a forecast can be viewed as the scenario with the most probable assumptions on exogenous variables. If there is great uncertainty on future policy or on exogenous developments (world trade, oil prices, threat of war etc.) the forecasting agency is to publish a number of scenarios instead of one central forecast. The number of published scenarios should be even since otherwise the public may choose the middle scenario as the actual forecast. Moreover, forecasters should also label their forecasts as scenarios when the forecast shows unwarranted future developments. In that case the forecaster wants his forecast to be self-defying. We can distinguish between three goals for the scenario analysis, namely:

- to advertise a warranted development
- to prevent an unwarranted development
- to cure an unwarranted development.

There are two different construction methods in scenario analysis (see Jungermann, 1985). The *exploratory scenario* is based on forward inference and looks at what happens if a specific exogenous event occurs, or policy measure is taken (or not). The *anticipatory scenario* is based on backward inference and indicates how a fixed policy goal can be reached.

Policy simulation is the most common and oldest purpose of use of macroeconomic models. Such simulation gives the model's response to an autonomous shock in a policy (or other exogenous) variable. The result of policy simulations are usually presented in the format of impulse-response tables, which show the difference between the central or baseline projection and the alternative or impulse projection. When Tinbergen presented his macroeconomic model for the Netherlands in 1936, which was also the first macroeconomic model of this type in the world, he already used the model for policy simulations and calculated such impulse-response effects, which in Dutch are known under the label of "spoorboekjes" (railways timetables).

a smaller prediction error may just be good luck and not a systematic result. But finally and most importantly, these comparisons do not learn us *why* the prediction errors are made and *why* some models or methods are better than others. Therefore, they are not very helpful in improving the forecasting performance.

Hence, in my view, it is much more useful to compare the performance of models in such a way that we can learn about strong and weak points of the forecasting procedure. In this vein Fair and Shiller (1989, 1990) compare the informational content in forecasts from economic models and in forecasts combining economic models with judgement. Such investigation does not only indicate to what extent forecasters use different information, or all relevant information available, but it also gives a clue for combining the forecasts in order to improve them. In the same vein McNees (1990) investigates the extent to which judgement is helpful to improve mechanically generated forecasts. He concludes that the historical records suggest that judgemental adjustment improves the forecasts, despite instances of success of mechanically generated forecasts. Moreover he looks at whether forecasters who combine their forecasts with judgement overadjust or underadjust. In other words, whether they put to much or to little trust in the mechanically generated forecast from their models. McNees finds a slight overadjustment. The message therefore is that forecasters should adjust their models using judgement, but that they should be very careful about it. It is, according to McNees, a mistake to accept adjustments that are made at face value, especially when the adjustments appear without any explanation of the reasoning behind them.

For that reason an extensive so called *post-mortem* analysis of prediction errors should be an essential part of the forecasting procedure. Prediction errors may have various causes, and in order to improve his forecast the forecaster should know which cause has led to his failure in the past. As possible causes we mention

- model specification error
- wrong coefficient values in the behaviourial equations, for instance because of an inadequate estimation technique or because of lack of data
- prediction errors of exogenous variables, for instance of the policy stance
- errors in add-factors, and hence a wrong judgemental adjustment
- the use of preliminary data on lagged endogenous variables, and on exogenous variables, which are revised afterwards[2].

However, in practice it may be very difficult to discriminate in a post-mortem analysis between these various sources of forecasting errors. Even with the benefit of hindsight it is almost impossible to determine whether a prediction error has been caused by the wrong specification of economic behaviour or by a shift in preferences which should have been met by an add-factor. Moreover, even a perfect forecast does not give us good comfort because it can be the result of two large forecasting errors that incidentally compensate each other completely.

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[2] See Gallo and Don (1988), and Van Vlimmeren, Don and Okker (1991) for the relationship between forecast errors and data uncertainty due to revisions.

vintage approach for modelling productive capacity and labour demand. This model from the new generation has been instrumental for the general political consensus on the shift from Keynesian demand policy to a policy of wage moderation in order to combat unemployment.

The third generation of models was built at the beginning of the eighties. These models comprise a fully fledged description of the monetary sector. This change of the generation of models has played an important part in the actual policy in the Netherlands as well. The government agreement of the Lubbers-I cabinet in 1982 heavily relied on the first outcome of the new FREIA-model of the CPB. This model of the third generation showed that cuts in government spending would, on the short run, be unfavourable to economic activity because of the demand effects, but on the other hand would be favourable in the long run because the reduction of the government deficit resulting from the cuts in government spending would reverse the crowding out mechanism and would consequently enhance economic activity. For that reason the reduction of government spending has become one of the main elements of the policy program of the Lubbers-cabinet.

Moreover, in the eighties a proliferation of the use of macro models for forecasting and policy analysis has taken place. The CPB lost its monopoly in this field as other government agencies, the Central Bank and research institutes at universities started to use their own models.

Yet, the CPB has remained by far the most important and prestigious producer of model-based forecasts in the Netherlands. Three annual publications are important in this respect. Each year in September, at the presentation of the new government budget, the CPB publishes its "Macro-Economische Verkenning" (MEV, Macro-economic Outlook), which contains forecasts for the following year. Then, at the end of April of the following year, the forecasts for that year are updated in the "Centraal Economisch Plan" (CEP, Central Economic Plan). Moreover, in addition to the Central Economic Plan, the Central Planning Bureau has started in 1989 to publish "Het Economisch Beeld" (EB, Economic Prospects) which contains a first analysis of the economic development and forecasts for the next year. The forecasts are again updated, but not officially published, in December and June in the so called "Halfjaarlijkse Tussenrapportage over de Nederlandse Economie" (semi-annual intermediate report on the Dutch economy).

The foregoing surveys the CPB's calender of publication of short-term forecasts. Additionally the CPB publishes medium-term forecasts, for the next five years. The CPB used to publish these medium-term forecasts each five years but recently these forecasts are updated more frequently (see Van der Lem and Zalm, 1989). Don and Van den Berg (1990) provide an interesting survey of the forecasting procedure and the calender of activities of the CPB during the period November 1988 - October 1989. They report that the decision to publish the April forecasts for the following year in a separate publication (EB, Economic Prospects) and not in the Central Economic Plan had a legal and political background. When published in the CEP the Government would be legally bound to the CPB's estimates and views, which was regarded as premature at that stage.

Table 1 collects the forecasts for 1991 of the various institutions and forecasting groups mentioned above. It illustrates that the revisions of the CPB's forecasts, made during 1990, are rather small, but for the balance of payments. The April 1991 forecasts by the CPB for 1991 show considerable upward revisions of the volume of consumption and of wage growth (which has become a major policy issue in the Netherlands), and downward revisions of the price index of exports and of the volume of imports. The forecasts from Groningen are quite in agreement with the CPB's forecasts, made at the same moment. Here the main exception is investment growth.

6. Conclusions

This essay confronts the science of forecasting with the art of forecasting. It shows how the macroeconomic forecasts used in policy analysis originate as a mixture of scientific knowledge and judgement. The last part of the essay surveys macroeconomic forecasting and model-based policy analysis in the Netherlands against this methodological background.

The following statements summarize the views expressed in this paper:

1. Fully mechanized forecasting methods are not very useful to the professional forecaster: it resembles a crystal ball without the crystal gazer to interpret the mirror image of reality.
2. Macroeconomic forecasts made by professionals always contain judgement and are never solely based on the outcomes of the models.
3. Further sophistication of econometric methods will not contribute much to the improvement of the forecasts.
4. The scope for economic theory in improving the forecasts lies not so much in providing better specifications for the models, but in gaining a better understanding of the working of the economy so that founded judgement can be incorporated into the forecasts.
5. A substantial improvement of the macroeconomic forecasts is not to be expected as the predictive accuracy of the economic future seems bounded by an upper limit; better data from statistical sources or more sophisticated scientific techniques will not be raise this limit very much; Samuelson (1975) feels as if there is a Heisenberg indeterminacy principle dogging us, which will limit the asymptotic accuracy of forecasting we shall be able to attain.
6. Model-based economic policy analysis is a much broader profession than just making forecasts; scenario analysis and policy simulations can be as fruitful for policy design than the provision of good forecasts.
7. Competitions of forecasting performance between models or modellers, based on a comparison of prediction errors only, does not provide much relevant information for improvement of the forecasts; scarce research resources are much better allocated by analyzing and comparing the information contents of the various forecasts.
8. Model-based policy analysis has always played an important part in the design of macroeconomic policy in the Netherlands; the recent proliferation of models which are used for forecasting, brings about the need for comparative studies on

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