

Econometric Research and Special Studies Department

Forecasting at the Central Bank: still à la mode?

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FORECASTING AT THE CENTRAL BANK:

still à la mode?

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ABSTRACT

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This paper presents a reflection on and assessment of the practice of forecasting at the Bank. The focus is on macroeconomics, and the currency circulation both domestic and Euro area wide.

Key words:

JEL codes: C5, E3, M2

SAMENVATTING

Voorspellen bij een centrale bank: nog steeds à la mode?

M.M.G. Fase

Dit rapport biedt een reflectie op de beoordeling van de voorspelpraktijk op de Bank. De aandacht gaat daarbij in het bijzonder uit naar de macroeconomische prognoses en die voor de circulatie van munten en bankbiljetten in zowel Nederland als het Eurogebied.

Trefwoorden:

JEL codes: C5, E3, M2

1 INLEIDING

Seven years ago, I gave a lecture at the University of Amsterdam carrying the title 'Forecasting is an art, also at the central bank'¹. In this lecture the question was raised whether models are a necessity or not. Today, I will not deal with this question again, but will start off by saying and emphasizing that I am convinced that econometric models are important tools for the design of economic or business policy. The same is evidently true of forecasting. Econometric techniques are often used to establish stylized facts in order to analyze future developments and to generate forecasts. I am also still convinced, and maybe even more so than before, that forecasting is a kind of art. What I mean to say is that it is often not the econometric model alone that is used to forecast. Forecasts often require further creativity in order to come to an estimate of the future developments to be investigated. Let us call this 'future development' the projection. Projections are made by using the econometric framework for forecasts complemented with 'judgemental' elements. The 'optimal' mix of econometrics and judgement is, unfortunately, hard to determine; in general this will depend on the topic, on the timing, and on many other factors as well.

Talking about macroeconomics, I think that, given the current developments in the world and in Europe in particular, macroeconomic forecasting on e.g. economic growth or inflation, has not become easier. This definitely holds for a small open economy like the Netherlands, but also for Euroland as a whole. The Netherlands has always been influenced considerably by developments in neighbouring countries, such as Germany. In Europe we now have a common market. The European Economic and Monetary Union has been established with a single currency, the euro, and a common monetary policy. In addition to this great institutional change, capital flows have substantially increased because of capital liberalisation and deregulation. New technologies like the Internet with electronic payment possibilities and novel communication tools like mobile phones have accelerated this process even further. As uncertainty tends to grow, and economies become more integrated, there is surely more need for forecasts and financial risk-analyses, requiring predictions. On the other hand, fortunately, we have gained more knowledge in the field of econometrics and have improved on data collection. New analytical and statistical techniques enable researchers to use vast and reasonably easily accessible data sets to accomplish their work. These data can be exploited to examine economic phenomena in a far more elaborate manner and shorter time span than in the earlier days of e.g. R. Stone, when he wrote his article the 'Fortune teller'. This article is a

¹ M.M.G. Fase, Forecasting is an art, even for the central bank, *De Nederlandsche Bank, Quarterly Bulletin*, 1991, nr 4, 73-81.

review of Collin Clarks's provocative 'The economics of 1960', published in 1942 ². In this interesting monograph Clark attempted to forecast the future but Stone could not resist the temptation to call Clark's projections 'fortune or storytelling', reflecting his own scepticism on forecasting.

At the Bank forecasting is an essential part of to days research. In monetary policy, questions concerning future economic growth and future inflation in the Netherlands and Euroland surely need to be monitored and therefore forecast on a highly frequent basis. Also, in the payment system the demand for banknotes and other payment instruments are forecast on a regular basis. In this article I will present some forecasting exercises undertaken at the Econometric Research and Special Studies Department of the Bank to illustrate this practice. With these examples I will try to indicate to what extent econometrics and judgement play a role. Furthermore, I will reflect on what we have learned and which new avenues could be considered to improve our work.

² See *Economica*, 1943, x, p. 24-33.

2 FOUR FORECASTING EXAMPLES FROM THE BANK'S PRACTICE

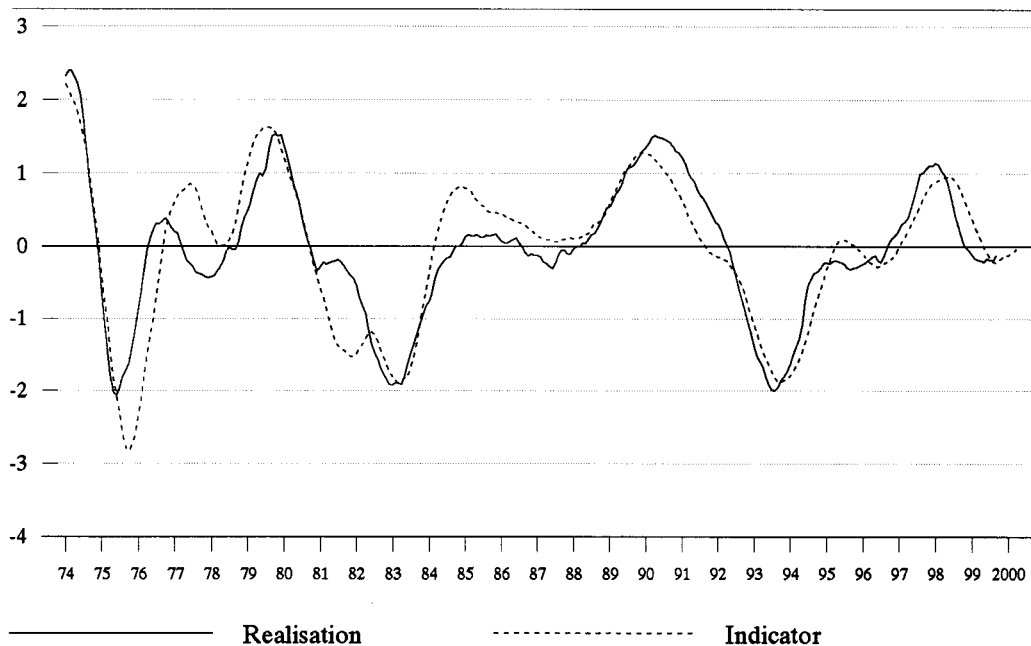
One rather simple, though essential, example is the Bank's profit, which comes under the non-tax revenues of the Treasury, the Bank's sole shareholder since 1948. The Bank generates profit because a substantial part of its liabilities consists of banknotes where no interest is paid, while on the major parts of its assets interest is received. The projection of the Bank's profit is based on an accounting framework. This framework bears in mind the development of the Bank's assets and liabilities and their corresponding yields. Important exogenous assumptions which underlie the projection refer to interest rates and exchange rates. The profit projections are made frequently, often for one year ahead. For the Bank itself they are also suitable in order to assess, in a quick and convenient way, the impact of the given interest and exchange rate changes on its profit performance.

I have three other examples to show, which will be illustrated in some more detail than the above internal business-like illustration. The *first* example is the Bank business cycle indicator. With respect to this indicator -as with other indicators- no causal relations are assumed between the factors included. This characteristic evidently does not hold for macroeconomic models, i.e. my *second* example. In these models, the economic theory about private and public sector behaviour and monetary policy forms the basis, and many causalities are therefore explicitly assumed. In my view, macroeconomic modeling is an important part of our economic research although our research portfolio is diversified. The *third* example I want to discuss concerns forecasting the circulation of euro notes and coins. This is (most probably) a once-only topic though I envisage challenging research avenues here. The euro will be introduced in January 2002 in all EMU member countries. This implies for all EMU countries that their current currency circulation will completely disappear and be substituted by euro notes and coins. In order to do so for the Netherlands, the Bank had to forecast the demand for euro currency in 2002.

Example I: Forecasting the business cycle

The DNB business cycle indicator forecasts Dutch industrial production. Figure 1 shows this indicator along with the realisations over the time span 1984-2000. The realisations are in deviations from trend (this is the dotted line). The DNB indicator (the bold line) is also in deviations from trend and, as you can see, forecasts a couple of months ahead. The main purpose of the indicator is to act as an early warning

Figure 1 The DNB business cycle indicator



instrument that points out business cycle turning points. Just like projecting the DNB profit, projecting the industrial production has also become an exercise that takes place on a very regular basis ³.

The construction of the indicator is as follows ⁴. Five time series are selected as appropriate leading indicators. The five leading indicators presently used are (1) the IFO-indicator of Germany, (2) the expected economic activity in the Dutch economy, (3) real money demand M1, (4) three-months euro-guilder interest rate and (5) the Dutch yield curve. Each indicator is detrended by means of a Hodrick-Prescott filter. The DNB business cycle indicator is composed of these five series, that are each standardized and synchronised according to its business cycle. The lead of each series is at least six months and the correlation with industrial production is at least 0.7. The Bank's forecast of business cycle is a weighted average of the lagged five leading indicators, where weights follow from a principal components analyses. The impact of the indicator can of course always be questioned. The indicator can point out something about the near future that may induce policy makers, bankers, firms and households

³ The DNB business cycle indicator is published monthly in *Economische Statistische Berichten*. It was developed by M.M.G. Fase and J.A. Bikker, 1985, *Maandschrift Economie*, further referred to in Grandeur and malheur van de conjunctuurbarometer, M.M.G. Fase and H. van der Wielen, *Economische Statistische Berichten*, 1989, nr 3701, p. 332-336 and included in M.M.G. Fase, *Geld in het fin de siècle*, Amsterdam 1999, chapter 11.

⁴ For detailed information on the new methodology to construct the indicator, see L. de Haan and F.W. Vijselaar, de vernieuwde dnb-conjunctuurindicator, *Economische Statistische Berichten*, September 1998, 83ste jrg, nr 4165, p. 660-664.

to adjust their policy or behaviour. So, although we will never really know the precise impact of such an indicator, the signalling effect of this easy one-dimensional figure, might often influence future developments.

Some time ago, our Minister of Finance dropped the remark that the business cycle indicator used by the Central Planning Bureau (CPB) is 'better and clearer' than the one of the DNB. He was not explicit on the criteria he had in mind for 'better and clearer', but we at DNB did not understand him for reasons of empirical evidence and economic reasoning. As to the latter one important difference between the two indicators is that the CPB measurement includes not only the industrial production, but also includes construction and services. However, our own investigation on this topic has shown that these two additional sectors do not give a good indication of the business cycle. Furthermore, CPB usually presents two indicators instead of one: one is called short-leading and the other is long-leading. In making policy decisions, more information may sometimes be desirable, but then again, it may also lead to more confusion. Perhaps, this is the case with the two leading indicators of the CPB.

Example II: Forecasting by means of large macroeconomic models

Since January of this year, we have one common monetary policy within the EMU. For the Bank this means a substantial change. Instead of targeting the German Deutsche Mark, the policy strategy followed during the last few years, the Governing Council of the European Central Bank ('ECB') decides on monetary policy for the whole EMU area. The president of De Nederlandsche Bank is one of the seventeen members of this Governing Council. In the conduct of European monetary policy many factors are of importance. Price stability is aimed at, but it is price stability in the medium term. Hence, it is important to closely monitor those factors that can influence medium term inflation. In order to do so, the Bank has developed several large and small macroeconomic models which enable the Bank to make forecasts both for individual countries and the EMU as a whole, i.e. the euroarea.

The two most important models of the Bank are MORKMON and EUROMON. MORKMON is a quarterly macroeconomic model for the Dutch economy with a well developed monetary block. This model is very detailed, i.e. it has many equations and in particular the Dutch monetary sector is quite well-specified. Many foreign variables, like German GDP and world trade, are highly relevant to the Dutch economy and therefore drive the forecasts with MORKMON. These factors, though, are all exogenous in this model but forecast carefully and in different ways. EUROMON is also a quarterly model for Europe,

Japan and the US. It is far less detailed than MORKMON, but again includes a well specified monetary sector. Moreover, it is a multi-country model with currently 13 countries modelled explicitly. In the very near future the still missing (small) countries, Ireland, Luxembourg and Portugal, will also be included. Then, all countries of the EMU are represented in EUROMON, along with Japan and the US. International linkages are explicitly modelled through export relationships and currently a big effort is made to include also the output gap and financial wealth to account for inflationary expectations and financial distress.

EUROMON differs from MULTIMOD - the multi-country model used by the IMF - and NiGEM - the model developed by the National Institute in London - in several important respects. In contrast to MULTIMOD, EUROMON has equations that are all estimated separately (although some parameters are calibrated). As known, MULTIMOD is a model where many long-term parameter estimates are obtained by pooling techniques. This has the disadvantage that most countries exhibit to similar long-run responses to shocks. If we compare EUROMON with NiGEM, it is worth mentioning that in EUROMON more attention is paid to small countries like the Netherlands and Belgium. This is of course very important for the Bank, as is the detailed simulation exercise to examine the model properties and its forecasting power for EMU.

Some years ago, the Bank started to publish annual forecasts, for one to two years ahead. The Bank does this bi-annually with MORKMON, for the Dutch economy, and with EUROMON, for the main European countries. Along with these forecasts, also simulation experiments were published to evaluate, for instance, depreciations or appreciations of the European currencies vis-à-vis the dollar, or macroeconomic responses to movements in stock or housing prices. At the moment the main focus is on policy scenarios in EMU. It is further interesting that these publications have received much public attention and are used in policy discussions at the ECB. Nowadays, as monetary policy-making is in the hands of the Governing Council of the ECB, forecasting exercises are coordinated among the EMU countries. At the ECB meetings take place, where all national central banks of the European System of Central Banks (ESCB) participate in so-called narrow and broad forecasting exercises. In the narrow forecasting exercise only the Harmonised Index of Consumer Prices (HICP) is considered. Each country makes a forecast concerning the HICP of its own economy. In the broad forecasting exercise, much more variables are considered, and here also, each participating national central bank makes a forecast of its own (national) economy. In this process consistency is aimed at, among other things by initially assuming the same exogenous variables. This may seem logical and a good thing to do, but is not trivial at all. EMU-wide forecasts are afterwards constructed from these eleven individual country forecasts.

At the Bank the narrow forecast, i.e. the HICP forecast, is made by using a VARX model. This is a Vector AutoRegressive model where some variables are exogenous and others are endogenous. Currently, the endogenous variables concern four inflation components, i.e. wages, retail sales, producer prices and final product prices. Important exogenous variables are the dollar-euro exchange rate, the short-term interest rate, the long-term interest rate of the Netherlands and the world oil price. The VARX model is monthly and forecasts are made for about 15 months ahead. The main advantage in comparison with indicator models is that causalities are not neglected. In comparison with large macroeconomic models, like MORKMON and EUROMON, the forecast is more tractable and therefore more straightforward to understand.

For the broad forecasts, the Bank uses MORKMON and EUROMON. Of course, the main advantage of these exercises is that all important national and international linkages are incorporated. Inevitably, in these forecasting exercises a lot of judgement is involved. This is necessary as, for instance, developments in the Dutch labour market are hard to explain. An example is the considerable decrease in unemployment over the last three to four years whereas at the same time inflation stayed quite low. The explanation is particularly difficult to find along the lines of standard economic theory and, therefore, linear macroeconomic models are of no use either. Also the developments in the stock markets and the convergence of long-term and short-term interest rates, a process in the EMU countries that was set in train following the announced start of the EMU in 1999, are hard to explain in such a standard framework.

Nevertheless, macroeconomic models offer a useful framework to discuss new economic developments, to evaluate the impact of one macroeconomic factor on other economic factors, and to come up with a plausible economic story. This may be partly due to the non-linear set up of our models.

As known, the CPB has to publish projections for the Dutch economy on a regular basis, among other things on inflation as the Bank does. To illustrate this I show some statistics. To give an idea of the similarities and the differences between DNB and CPB forecasts the average absolute forecast errors (and the root mean squared forecast errors) for the 1990's and 1995-1998 have been calculated. For the CPB these statistics are 0.49 (0.69) and 0.43 (0.51) respectively while for the DNB 0.49 (0.64) and 0.18 (0.22) were obtained, indicating a slightly better forecasting performance of the Bank's model in the recent period. However, the important issue is to which this better outcome is due. Closer examination shows that the source of the discrepancies is twofold. For a large part this is due to different assumptions about the exogenous worldprices and exchange rate assumptions.

Quality tests like these, that compare forecast performances, are useful to maintain or gain credibility as an institution. However, they are definitely not univocal and to enhance its practical use perhaps subjective probability statements in the sense of degrees of belief should be attached to the predictions. However what I want to emphasize foremost at this point is that I see the use of large macroeconomic models still as an essential tool for the Bank's policy making. Their forecast performance may fluctuate over time, and the projections are never undisputable, but these projections are nevertheless very essential tools in the decision making, in our case monetary policy process. A similar view is held at the ECB in Frankfurt and its staff.

Example III: Forecasting the euro circulation

The final example I want to discuss is a more tangible forecast example⁵. As said before, in 2002, euro banknotes and euro coins will be put into circulation in the EMU countries. In the Netherlands this implies that the current twelve guilder-denominations -six banknotes and six coins- will be replaced by fifteen euro denominations. Compared with the present situation in the Netherlands one more banknote and two more coins will be introduced. This alteration in composition is a major problem in forecasting the disaggregated demand for euro notes and coins. As production has to start well in advance in order to produce the whole amount of notes and coins, anticipated forecasts per denomination were needed for a considerable period ahead, i.e. more than 3 years⁶. To give you an idea of the composition of the circulation, Figure 2 shows the composition in 1998, which was used as the base year in the forecast.

The Dutch notes circulation has been studied widely at the Bank. Already two decades ago an econometric model to forecast was developed⁷. This model explains the demand for each banknote by looking at personal consumption and short-term interest rates. As personal consumption increases, the demand for notes increases. Moreover, with the increase of nominal consumption, we see a shift towards the higher denominations, due to the pattern of elasticities. Next to this positive effect of consumption on demand for notes, the interest rate has a clear negative effect. Apparently, the demand for notes decreases whenever there is an opportunity cost of interest income.

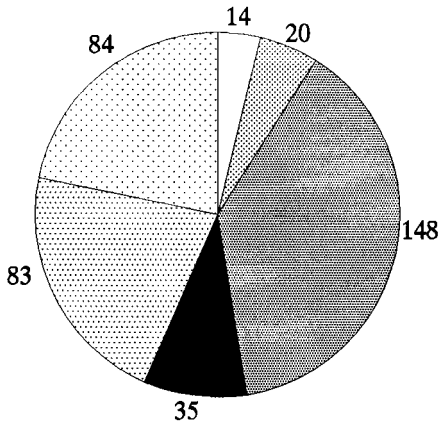
⁵ For more details on this issue, see G.E. Hebbink and H.M.M. Peeters, The circulation of euro banknotes and coins in the Netherlands, 1999, *De Economist* 147, 73-82.

⁶ As a matter of fact, production of both notes and coins started at the beginning of this year.

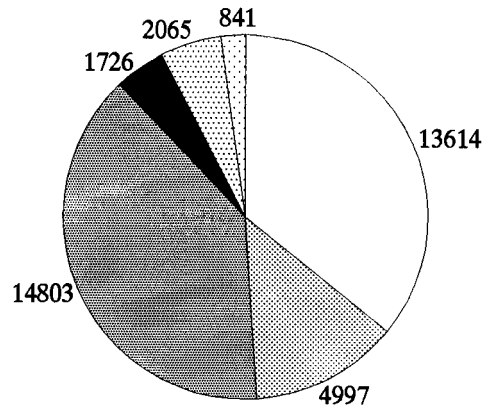
⁷ See e.g. M.M.G. Fase and M. van Nieuwkerk, 1976, The banknote circulation in the Netherlands since 1900; Prospect and Retrospect, *De Nederlandsche Bank, Quarterly Statistics*, pp. 175-194.

Figure 2 Break-down of composition of notes and coins in circulation in 1998

Number of banknotes
(in millions, 1998)

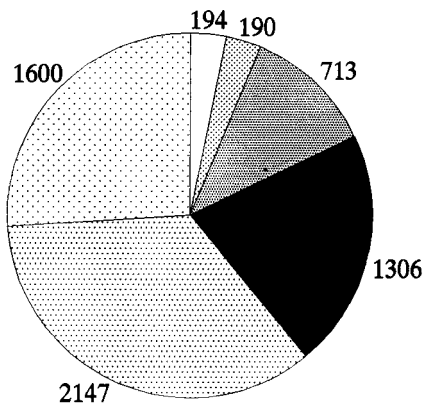


Value of banknotes
(in millions of guilders, 1998)

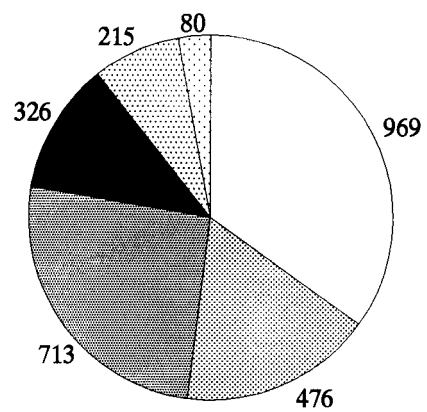


NLG 1,000
 NLG 250
 NLG 100
 NLG 50
 NLG 25
 NLG 10

Number of coins
(in millions, 1998)



Value of coins
(in millions of guilders, 1998)



NLG 5.00
 NLG 2.50
 NLG 1.00
 NLG 0.25
 NLG 0.10
 NLG 0.05

Empirical research shows, however, that the effects are only significant for the larger denominations. Recently, the point-of-sales terminals (POS terminals, for short ⁸) and other innovations in the payment system have been added. To give you a flavour of these influences, the estimated impact elasticities of main factors involved are shown in Table 1.

Table 1 The long-term (semi-)elasticities

Denomination	Private consumption elasticity	Short-term Interest rate Semi-elasticity	POS-turnover Elasticity
NLG. 1,000	0.95	-0.097	0
NLG. 250	0.92	-0.033	-0.034
NLG. 100	0.89	-0.018	-0.039
NLG. 50	0.75	0	-0.040
NLG. 25	0.66	0	-0.047
NLG. 10	0.52	0	0

Long run relationship : $CU_{IT} = \beta_0 + \beta_1 C_T + \beta_2 R_T + \beta_3 POS_T$

In contrast to the notes circulation, far less research has been done on the coins circulation ⁹. For the purpose of forecasting the need for coins in 2002, an unrestricted VARIX(1,1) was therefore estimated ¹⁰. Thus, on the basis of assumptions about future developments with respect to consumption, the interest rate and the use POS terminals, forecasts were made. In this way forecasts for each coin denomination in 2002 become available. In order to forecast the euro circulation, however, two important additional assumptions were made. First, an assumption was needed on the conversion from guilders into euro. As we do not have any relevant benchmark or knowledge, this is carried out in a pragmatic way as shown in Table 2. Here, as one can see, the demand for the EUR 200 notes for which we do not have an equivalent in guilders, is assumed to consist of 20% of the notes of NFG 1000 and 80% of notes of NFG 250. A similar assumption is made for the (new) coin of 20 euro cents. The demand for the coin of 1 euro cent is finally assumed to equal 40% of the NFG 0.05. Second, more factors than only consumption, interest rates

⁸ Along with the POS terminals, the cash dispensers also play an important role. As yet, no long times series exist on the use of the cash machines. But the effect of the cash dispensers on the demand for notes remains an item on the DNB-agenda for future research.

⁹ See chapter 10 of M.M.G. Fase, *On Money and Credit in Europe*, 1998, Edward Elgar, UK.

¹⁰ A VARIX(1,1) is a Vector-AutoRegressive process of first order, that is integrated of first order, and has additional exogenous variables.

Table 2 Assumed conversion ratio from guilders into euros

	500	200	100	50	20	10	5	2	1	0.50	0.20	0.10	0.05	0.02	0.01
1,000	80	20													
250		20	80												
100				100											
50					100										
25						100									
10							100								
5								100							
2.50									100						
1										80	20				
0.25											20	80			
0.10													100		
0.05														60	40

Vertical axis: guilder-denominations. Horizontal axis: euro-denominations. For example: Fl. 1,000 is assumed to be converted for 80% in 500-euro-notes and for 20% in 200-euro-notes.

and POS-turnover will influence the demand for euro notes and coins. One such factor is electronic money. One may suspect that electronic money may have an impact on future circulation by the more and more intensive use of the Internet. Another factor is that not each guilder note and coin currently in circulation, will be offered for exchange in 2002. In particular, coins are often lost, kept by tourists as a collector's item. This characteristic will also reduce euro demand. Although these latter factors are extremely hard to measure, they will definitely have a substantial impact. Therefore, the impact is roughly estimated by means of proxies taken from other studies. The final result is that we arrive at projections of all fifteen euro-denominations in notes and coins as shown in Figures 3 and 4.

What I would like to illustrate with this forecasting example is again the mixture of econometrics, pragmatics and economic intuition leading to projections or judgemental forecasts that are used as an input in the policy-making process. In this case this policy concerns the payment system, that is still an important task of the Bank according to the "Bank Act" 1998 (that replaced Bank Act 1948).

Figure 3 Forecasts banknote circulation (millions)

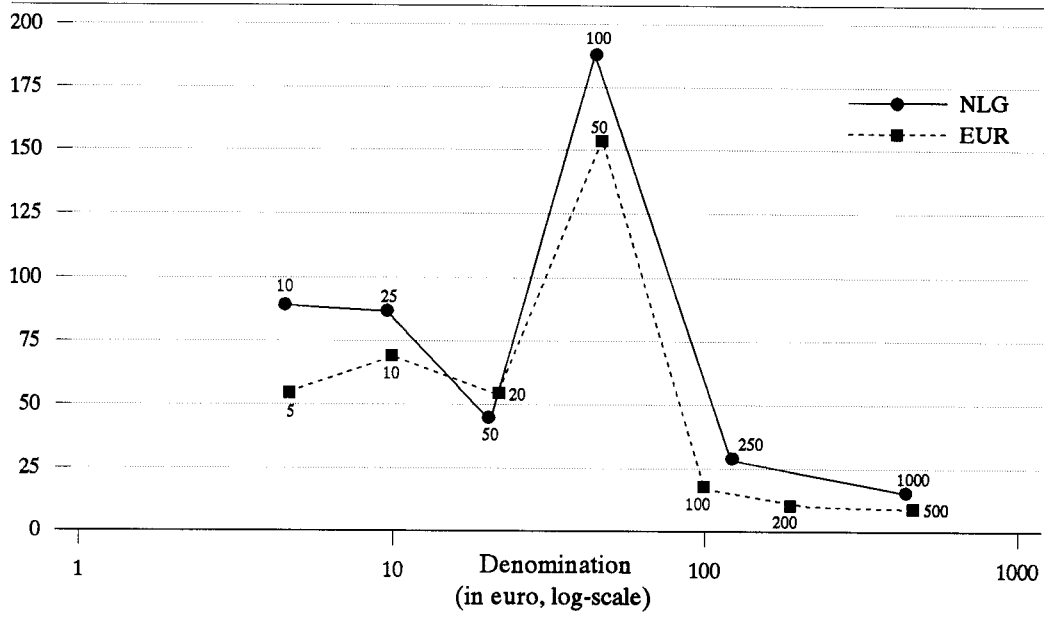
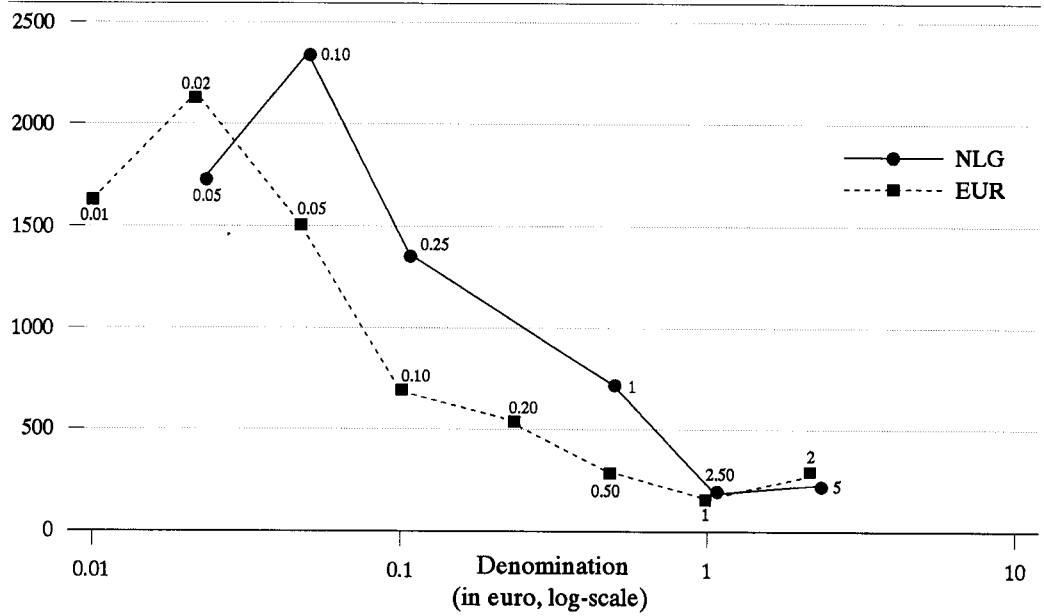


Figure 4 Forecasts coin circulation (millions)



3 A REFLECTION ON A FUTURE AVENUE

At the end of this paper, I want to return to stress once again, referring to the four examples given before, that forecasting at the Bank is still part and surely will remain part of her daily practice. So, the answer to the question raised in the title of this paper is confirmative: forecasting at the central bank is still à la mode¹¹! Talking about the methodology followed when forecasting, and playing on words like the *The Economist* tends to do - probably to make economics more attractive - I hasten to add that, in case the distribution of the forecast is asymmetric, my focus is not on the mode but on the median, and that rather than probability I, as indicated above, want to attach à la the young Keynes at forecasts a degree of belief or subjective probability¹².

Ten years ago, in a provocative essay, the American new Keynesian scholar N. Gregory Mankiw pointed out a difference in sympathy of large-scale macroeconomic modellers and a majority of those in the academic macroeconomic profession¹³. He questioned the behaviour of many academics in their dislike of large-scale macroeconomic models and forecasting. In Mankiw's view - which I share - these rational expectations people neglected the wealth of information included in macromodel use by policy makers. According to Mankiw, this seems to be contrary to rational behaviour seeking to exploit all available information. And macroeconomic forecasters surely generate relevant information for decision making.

As to the question what new avenues could be explored in modelling, I think that we should try to incorporate forward looking behaviour à la rational expectations to get, for instance, a better understanding of the capital flows in the world. The fact that we have much more integrated capital markets and that financial crises, as we have recently seen, can occur quite fast and have an enormous economic impact, has triggered new research fields already. Also, to come back in particular to EMU, the impact of the mergers and acquisitions among commercial banks and insurance companies, leads to huge financial conglomerates, requiring a new type of research. Again modelling and forecasting may be useful although regulatory issues are also quite important. These studies should of course take maximum advantage of the micro data that have become available.

¹¹ A phrase referring to Ken Wallis's comments on inflation forecasting at the Bank of England and the visual aids employed. *The Economist*, Finance and Economics: Economics Focus, titled *A la mode*, March 27th 1999, p. 90.

¹² J.M. Keynes, *A treatise on probability*. London 1921.

¹³ N.G. Mankiw, Recent developments in macroeconomics: a very quick refresher course, *Journal of Money, Credit and Banking* 20, (1988), 436-449.

Micro studies, also on firm and consumer levels, could generate much more knowledge about monetary transmission than presently available, taking into account that the strength of monetary transmission differs across countries and financial arrangements ¹⁴. I strongly believe that in this field the research network of national central banks created in the ESCB may be of vital importance.

This network also enables researchers to incorporate institutional elements to examine e.g. the monetary transmission processes. On this issue there are still important differences in institutional detail between the UK and continental Europe that count for the transmission process. Therefore, I think that macro- and micromodelling as well as forecasting will remain important analytical and practical tools.

¹⁴ M.M.G. Fase and G.A. de Bondt, Institutional environment and monetary transmission in the Euro area, *Revue de la Banque*, nr. 1 2000 (forthcoming).

