Behavioral Macroeconomics II

I am now going to put yesterday's model of expectations together with the simplest model which might be called macroeconomic. This model is much simpler even than the simplest model real live macroeconomists ever use -- the 3 equations New Keynesian model used by De Grauwe.

To recap yesterday's lecture, agents are assumed to consider two possible forecasting rules. One is that the future is like the recent past (extrapolation) and the other that variables return to some unconditional population mean (fundamentalist). Agents are assumed to choose between the rules based on past forecasting performance. With some hand waving, "past performance" means a geometrically declining weighted average of lagged squared forecast errors.

Yesterday we did not and today we won't distinguish between two possibilities: the weights based on past performance might be used by each agent to make a forecast which is the weighted average of the two rules (so all have the same forecast) or the weights might describe the fractions of the population which use each rule (so there are two different forecasts made by different agents). It is conventional to discuss the models using the second assumption (De Grauwe does this) but also to use models so it doesn't matter which is true. The distinction will be important in this course. But not today.

In the "recap" paragraph, I cheated a little. I have replaced "extrapolate a trend" with "forecast that the future will be like the recent past." The reason is that the most obvious applications of the psychological results tend to lead to extremely unstable models. This brings us back to the key problem that once one abandons full rationality, one is too free to assume what one pleases. I won't apologise for this (in writing) again (I might not be able to stop saying it).

The forecasts are either "extrapolative" with expected income Y^e = lagged income Y_{t-1} or "fundamentalist" with Y^e = a constant Y_0. In this model, the forecasts of mean reversion include immediate return all the way to the unconditional mean.

OK the "macroeconomic" model is really the simplest model of consumption combined with the simplest possible national accounts identity

1) $Y = C$

In words, it is assumed that agents produce goods from labour alone and that there is no capital or investment, the economy is closed so there are neither imports nor exports and there is no state so there is no public spending or taxation.

Time is discrete. Immortal agents attempt to maximize the present discounted value of a stream of utility from consumption discounting with a subjective discount factor 1/(1+d). Finally I assume prices are fixed – agents just supply as much as is demanded and never even think of raising prices.

My aim is to justify use of a subjective version of the Euler equation. One way to do this is to just assert it is a valid description of behaviour without any discussion of what agents think or why they do what they do, but I am going to try to tell a story about not necessarily rational beliefs which cause agents to choose consumption so that

2) $C_t = C_{t+1}^e(1+d)/(1+rr_{t+1}^e)$

Where e superscript refers to the consumer's forecast of the variable (which is not the optimal rational expectations forecast), d is the rate of impatience and rr is the real interest rate.

to make things as simple as possible start by assuming that that there is a fixed known exogenous real interest rate rr = d.

That sure is simple. However, there are still tricky questions. Agents choose subjectively optimal consumption at time t, that is they choose consumption which they think will maximized their expected utility. To do this, they need to have an belief about their infinite horizon budget constraint. But the experimental evidence only concerns short term forecasts.

I'm sure you can guess that the model will imply a subjective version of an Euler equation in which the expected rate of growth of consumption is related to expected real interest rates (which for now I assume are constant). But this is the result of optimization by an agent who thinks she can forecast the distant future too. It is also a necessary but not sufficient condition for an optimum – the budget constraint also has to hold with equality.

With assumptions it is possible to make the consumers' problems easy. For example, we could assume that expected income Y^e means expected labour income at all periods t, t+1 and forever. In that case, an agent with financial wealth zero will choose consumption $C = Y^e$. An agent with financial wealth A (who is free to borrow if A<0) will choose $C = Y^e + rrA$. This makes for a model which is so simple that it is boring.

To make it interesting, add some mysterious demand shock so the equation gives the expected value of consumption. To make sense, the shocks have to be taste shocks (impulse buying ?).

This is enough to have a model of a sort which can be simulated.

A problem with this model is that the agents are really really dumb. It is assumed that they use only the performance of one period ahead forecasts to evaluate the two forecasting rules. But the rules imply many periods ahead forecsts – an ignorant but rational agent would think "3 periods ago, I used the extrapolating rule and predicted that income last period would be $Y_{t-4} > Y_0$ but actually it was less than Y_0, so the extrapolative rule didn't do very well. " Such reasoning is too complicated for simple simulations.

To reconcile the model with the idea that agents are trying to maximize expected utility given irrational expectations, it helps to be a bit vague. They act as if they are sure that Y will be Y^e from t on. They actually think that (Y_t-Y^e) is a normal innovation, so they can use forecasts of period t to update weights on the two forecasting rules, and they believe something vague about the distribution of Y_{t+1}, Y_{t+2} etc so that they consume as if they were sure they would be equal to Y_t, but also so that the performance of two and more period ahead forecasts isn't useful when deciding which forecasting rule works best.

Maybe it is best to forget entirely about subjective expected utility maximization and just assume that an extrapolator chooses $C_t=Y_{t-1}$ and a fundamentalist chooses $C_t=Y_0$ and, also separately that agents change weights on the extrapolative strategy (or switch from extrapolative to fundamentalist and back) based on the (geometrically decreasing in lags) weighted sums of the squared forecast error terms $(Y_t-Y_{t-1})^2$ and

$(Y_t-Y_0)^2$.

Full Euler Equation

Well that simplest model was a bit complicated. Now for the second simplest model, agents also attempt to forecast the real return paid at time t+1 , t+2 etc. Now, for one thing, I will have to choose a functional form for the utility function so I can solve for consumption given r. I will assume that u(C) = ln(C) .

Again to make the problem simple, assume that agents think everything will be as simple as possible from t+2 on. Assume they think that $rr_{t+s} = d$ for s>1, so labour income will be constant and so will consumption. This gives $C_t= (1+d)/(1+rr^e_{t+1})Y^e$. That looks just like an Euler equation with subjective expectations in the place of conditional means. Now again assume that, whatever, vague belief people have about real interest rates paid 2 periods ahead or more, they aren't useful when evaluating the forecasting rules.

This is a huge amount of hand waving just to justify using an Euler equation with subjective expectations in the place of conditional means. The points, if any, are two.

First (this is due to Guido Cozzi who taught behavioural macroeconomics some years ago and Alessandra Pelloni) De Grauwe pulled a trick or in US slang a fast one (which I have made painfully slow). The Euler equation is the result of analysis given expectations about the distribution of future events for all time. It can't be justified if we only think about what one period ahead forecasts people make.

Second, there are lots of possible assumptions about the distant future that people could make so the Euler equation holds with subjective (irrational) one period ahead forecasts and it is reasonable for them to confront those forecasts with outcomes to evaluate and adjust their forecasting strategies.

It is probably best to assume agents behave according to the rule which looks like an Euler equation. It might be best to skip all appeal to subjective utility maximization and just assume that demand is decreasing in the expected real interest rate if other things are equal, and that the other thing is somehow related to optimism and pessimism about future income.

It is very convenient to assume logarithmic utility, because it makes it easy to model consumption of an agent with non-zero financial wealth A. That agent's consumption is what it would be if A were zero plus Ad. It depends only on the rate of impatience and not at all on expected real interest rates, because the income and substitution effects cancel. So for that utility function and only that utility function it is possible to derive a very simple model of wealth dynamics from subjective expected utility maximization.

Getting To an Actual Macroeconomic Model

In the real world, nominal interest rates are known. Also monetary policy is achieved by targeting a short term safe nominal interest rate. So it is absolutely standard to assume that agents see the nominal interest rate and attempt to forecast the real interest rate by forecasting inflation. So inflation extrapolators predict that inflation from t to t+1 will be equal to inflation from t-1 to t and inflation fundamentalists assume inflation will be equal to a constant.

This means that extrapolators do, in fact, extrapolate the recent trend of the price level. In contrast inflation fundamentalists assume the price level is a random walk (not really mean reverting).

Notice that if we assume that everyone predicts real demand Y either with pure extrapolation or with a constant, and that everyone either extrapolates inflation or assumes it will be a constant, that there can be four types of agent. An agent can be a demand extrapolator and an inflation fundamentalist.

The two types of inflation forecast are actually very famous. Fundamentalist inflation expectations are called "anchored" expectations. Extrapolative inflation expectations are called de-anchored or autoregressive. Central bankers are pretty much all firmly convinced that expectations may be anchored or de-anchored and that expectations de-anchor if inflation is persistently far from their target. De Grauwe's model of inflation expectations is pretty much definitely the model which all central bankers currently use no matter how polite they might be to the staff of their research departments where rational expectations models are developed.

The ultra simple model discussed above is actually complicated enough to give interesting results, but to get to De Grauwe's model, we need two more equations. His model is a behavioural version of the three equation new Keynesian model. One of the three equations is the Euler equation. Another is a Taylor rule used by the monetary authority to set the nominal interest rate. It is a horrible convention of business cycle macro that r is used to refer to the nominal interest rate.

The Taylor rule is

3) $r_{t+1} = c1\pi_t + c2Y_t$

where π_t is inflation from t-1 to t. notice that the monetary authority is assumed to get real time information on inflation and output so the interest rate to be paid in period t+1 is set based on output and inflation at time t.

Finally, the model is completed with a new Keynesian Phillips curve

4) $c1\pi_t = b1\pi_{t+1}^e + b2Y_t$