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Comparing behavioural and rational expectations for the US post-war economy☆

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ABSTRACT

The banking crisis has caused a resurgence of interest in behavioural models of expectations in macroeconomics. Here we evaluate behavioural and rational expectations econometrically in a New Keynesian framework, using US post-war data and the method of indirect inference. We find that after full reestimation the model with behavioural expectations is strongly rejected by the data, whereas the standard rational expectation version passes the tests by a substantial margin.

1. Introduction

Since the banking crisis of 2007 there has been a resurgence of interest in macroeconomic models embodying expectations-formation other than rational expectations. Evidence of biases in expectations, of herd behaviour and of chart-following has been found by a number of researchers in behavioural economics— for example, Kagel and Roth (1995), McCabe (2003), Camerer et al. (2005), Della Vigna (2009), Kirman (2011) and De Grauwe (2010) have suggested that such behaviour can be found at the macroeconomic level also (they reject the 'rational learning' models of Sargent (1993) and Evans and Honkapohja (2001), in which for many cases learning converges on rational expectations).

There is also work on behavioural switching models fitting various time series data. The reinforcement learning mechanism with switching between forecasting strategies has proven to be successful in describing individual expectations using both survey data (see, e.g., Branch, 2004) and experimental data (see, e.g., Hommes, 2011). Moreover, recent empirical applications of reinforcement learning models fit data and reproduce stylized facts in the S&P500 market index (see, e.g., Boswijk et al., 2007), in the DAX30 index options (see, e.g., Frijns et al., 2010) and in the Asian equity market (see, e.g., De Jong et al., 2009). Furthermore, recent empirical papers question the assumption of rational expectations. For example, Rudd and Whelan (2006) estimate a New Keynesian Phillips Curve and they find no evidence in post-war US data that inflation dynamics reflect the rational behaviour hypothesized by the standard model. As another example, Carriero (2008) tests the assumption of rational expectations in the setting of a New Keynesian Phillips Curve and he finds no combinations of structural parameters consistent with both the restrictions imposed by the model under rational expectations and US data. However, as pointed it out by ap Gwilym (2010), it is hard to empirically distinguish a behavioural model of stock prices from a rational expectation one.

There is therefore a wide range of work that supports the presence of some type of behavioural expectations in the economy. However, there is no overall test of how far behavioural expectations can account for macroeconomic behaviour in general, as compared with the usual workhorse of DSGE models, rational expectations. Here we focus on this issue, which is clearly of great importance for policymakers.

In this paper, we test a particular model of bounded rationality (that of De Grauwe, 2010), characterized by one specific set of forecasting strategies, within the standard New Keynesian model; in parallel we test the same model with rational expectations. We examine how far these two models can account for US business cycle behaviour over the past few decades including the recent crisis period. Clearly there is a whole spectrum of behavioural expectation assumptions we could have tested instead of the De Grauwe model; whereas rational expectations are tightly defined, behavioural expectations are by definition ad hoc, the point being that people have essentially unexplained biases. We chose the De Grauwe model as our exemplar because De Grauwe has been a well-known, widely-cited and persuasive advocate of the behavioural position in macroeconomics over recent years; clearly, our tests cannot be the end of the story since there is a large if not infinite

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Table 1
Rejection rates (for 3 variable VAR (Anderson et al., 1992).
Source: Le et al. (2012a,b).

Percent Mis-specified	Wald	LR
True	5.0	5.0
1	19.8	6.3
3	52.1	8.8
5	87.3	13.1
7	99.4	21.6
10	100.0	53.4
15	100.0	99.3
20	100.0	99.7

variety of alternative ways that behavioural expectations could be specified and so tested. It would be well beyond the scope of this one paper to investigate anything approaching this variety; our aim is simply to test a prominent variant to start a debate.

Our (indirect inference) procedure asks whether each model can match US business cycle behaviour, as described by the variances of the three main variables, output, inflation and interest rates, and a VAR embodying their inter-relationships. The match is gauged by a Wald statistic that has a well-defined distribution, enabling us to assess the statistical significance of fit. To enable each model to achieve its best possible performance, we allow its model coefficients to be reestimated and only perform the final tests after this has been done.

In using indirect inference to test the two models we deviate from the popular use of Bayesian methods in evaluating models. However, what is not often explained is that such Bayesian evaluation (by marginal likelihood and odds ratio tests) does not test any model as a whole against the data; indeed Bayesians dismiss the idea of 'testing models'. What Bayesian evaluation does is to estimate the model assuming the truth of the prior distributions and the model structure; then one variant of the model may, on those assumptions, turn out to be more probable. But the model in question may still be rejected, assumptions and all, by the data. Furthermore, a model which is 'less probable' under these assumptions than another model, may not be rejected, or may be rejected at a lower confidence level, than the other by the data.

Thus Bayesian methods cannot be used to test models against the data— our aim here. As an alternative to indirect inference for testing models against the data one may use the direct inference likelihood, as in the Likelihood Ratio test. However, as we elaborate below, this alternative method has considerably less power in small samples than the indirect inference test we use here; by implication indirect inference will provide more powerful discrimination between the models.

Bayesians may still argue that it is wrong to do what we do here: that one should not test models as a whole against the data but rather only check improvements conditional on prior assumptions which should not be challenged. However, in macroeconomics it is hard to argue that any set of prior assumptions can be taken for granted as true and beyond challenge. This can be seen from the number of 'schools of thought' still in existence in macroeconomics; this situation of a wide divergence in beliefs has been exacerbated by the financial crisis of the late 2000s. Whether one likes it or not as a macroeconomist one must recognise that to establish a model scientifically to the satisfaction of other economists and policymakers, it needs to be shown that the model being proposed for policy use is consistent with the data in a manner that enables it to be used for that purpose. We show below that indirect inference fulfils that need.

The models we test are identical in form, conforming to a standard New Keynesian model, with a forward-looking IS curve, a Phillips Curve, and a Taylor Rule governing interest rates. The only difference lies in expectation-formation. Thus the comparison precisely tests the different specification of expectations, allowing each model the benefit of reestimation of the exact parameter values. In the standard model these are rational expectations whereas in the alternative ('behavioural') version they are determined by groups of speculators who follow 'fundamentalist' and 'extrapolative' expectation patterns, as set out by De Grauwe (2010). While initially we calibrate these models with typical parameters found in the New Keynesian literature and we report these results in passing, the results we attach importance to are after reestimation (by indirect estimation) to allow each model to get as close as possible to the data, within the bounds set by its theory.

It might well be thought, given the events of recent years, that the standard model would perform badly over the recent post-war period, while the behavioural version would do well. However, we find exactly the opposite: the behavioural version is strongly rejected by the data (including the crisis period), while the standard version is not rejected at the usual significance levels. This apparently surprising result is of some importance to the macroeconomics debate of the current time and so we feel it deserves to be properly exposed to a broad economist audience.

In the rest of this paper, we first explain the models (Section 2); we then set out our testing and reestimation procedure (Section 3); we turn next to our results, first on calibrated (Section 4) and then on reestimated parameters (Section 5); Section 6 concludes.

2. The two models

The behavioural model is a stylized DSGE model similar to the model in De Grauwe (2010). It includes a standard aggregate demand equation, an aggregate supply function, and a policy rule equation, as follows:

$$\widetilde{Y}_t = \widetilde{E}_t \widetilde{Y}_{t+1} - a_1\left(R_t - \widetilde{E}_t \pi_{t+1}\right) + \varepsilon_{1t} \tag{1}$$

Table 2
Structural breaks test.

Test	Event		F-statistics		Conclusion	
			π	R	π	R
Chow	Sept. 11th attack	2001Q3	0.051575	0.501155	No	No
		2001Q4	0.202721	0.434604	No	No
	Financial crisis 2007–2008	2007Q1	0.067102	1.097126	No	No
		2007Q2	0.012518	1.622606	No	No
		2007Q3	0.152927	2.242481	No	No
		2007Q4	0.130049	2.679775	No	No
		2008Q1	0.561341	2.518808	No	No
		2008Q2	0.961695	1.382308	No	No
		2008Q3	1.883081	1.086589	No	No
		2008Q4	3.622815	1.812170	No	No
		2009Q1	0.000897	0.291587	No	No
Bai-Perron	–		5.703069	2.781012	No	No