NEW KEYNESIAN MODELS AND THE TEST OF KYDLAND PRESCOTT

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PRELIMINARY AND INCOMPLETE

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ABSTRACT

This paper evaluates New Keynesian models using RBC methods for a number of key macroeconomic variables. Its main findings are that the NK model provides a good description of the behaviour of real variables but performs very poorly when nominal variables are considered. The latter result is puzzling, given the success of NK models in replicating impulse response function and presents a challenge for current models.

JEL Classification: E32, E52, E58

Key Words: New Keynesian Models, Real Business Cycles, Correlations

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1. Introduction.

Beginning with Kydland and Prescott (1982) real business cycle (RBC) macroeconomics has led to sweeping changes in the way macroeconomics is conducted. There is greater emphasis on building models with strong microeconomic foundations, with the aim of overcoming the Lucas critique; the supply side was considered the economy's driving force and traditional econometric techniques were eschewed in favour of a more a-theoretical approach that attempted to replicate the data's second moments.

The current paradigm in macroeconomics, New Keynesian[2] is founded on many elements from RBC theory, but has placed greater emphasis on nominal rigidities and the nominal causes of output fluctuations – and consequently, less importance has been attached to technology shocks – and models are often evaluated by their ability to replicate the impulse responses obtained from vector autoregressions (VARs). But this focus on the effects of shocks, to the neglect of the model's systematic components, is likely to lead researchers to incorrectly conclude that their model performs well, as only one aspect of the model's characteristics is observed. The purpose of this paper is to argue that the RBC model evaluation methodology can still provide useful insights and that this is an area that should not be neglected. Evaluating a model solely on the basis of the cross correlations it yields and the standard deviations of the variables has its limitions; simply because a model is able to mimic the data does not mean that it can explain it and as King and Plosser (1994) found, one cannot distinguish between a Keynesian (Klein-Goldberger) and an RBC model when using the methods of Burns and Mitchell.

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[2] Also called New Neoclassical Synthesis (see Goodfriend and King, 1997).

Nevertheless, it provides a highly informative measure by which to measure a model. Indeed, whereas the New Keynesian (NK) theory developed as a result of dissatisfaction with the RBC focus on technology at the expense of monetary factors and the RBC failure to explain monetary phenomena, NK models also fail dismally in this dimension. Moreover, given the predominance of NK models in policy analysis this result is somewhat surprising.

The paper proceeds as follows. Section 2 will present the cyclical characteristics of a small subset of key macroeconomic variables that most modern small models generally include, so that the theoretical models can be evaluated using RBC methods. Section 3 will then present a NK model that is provides a good description of the models used currently to evaluate monetary policy. It will also include endogenous capital so that investment and consumption can be analysed separately. Section 4 then evaluates the model and also presents a model where the model is expressed in terms of the output gap and section 5 concludes.

2. Some Business Cycle Facts.

The study of the stylised facts of fluctuations has already been well documented. Therefore this section will provide a brief description of the variables of interest and interpretation. This paper will focus on a limited number of real and nominal variables that feature prominently in modern monetary policy analysis. These are consumption, output, investment, the inflation rate and the nominal interest rate. Since the relationship between real and nominal variables is likely to be unstable with changes in monetary policy regime - and hence the term "stylised fact" would be inappropriate - this paper will

focus on the period 1979:3-2001:2, so that it incorporates both the Volcker and Greenspan periods at the Fed. The data have been de-trended using the HP filter[3] on the grounds that this paper is focusing on fluctuations of 32 quarters or less, which is exactly what the HP filter yields as argued by King and Rebelo (2000). Moreover, using a band pass filter that discards the high frequency fluctuations does not change the main conclusions of this paper.

TABLE I

US BUSINESS CYCLE FACTS (1979-2001)

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
C	.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
FF	1.64	1.15	.77	-.43	-.28	-.11	.19	.42	.48	.47	.43	.40

Note: Y denotes real gdp; C is real consumption expenditure in nondurable goods and services; X is real private domestic investment and consumption of durable goods. PI denotes the GDP deflator inflation rate and FF is the federal funds rate (both annualised).

The second column presents the standard deviation for each variable, while in the third column these are stated as a proportion of the volatility of output. A standard result is that consumption is less volatile that output and the opposite is the case for investment. ρ_1 denotes the first order autocorrelation coefficient and the remaining columns present the correlation coefficient between each variable (at time *t+i*) with output at date *t*. . A large

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[3] With a value of $\lambda =1600$.

number in (absolute terms) appearing in column t + i (t - i) indicates that the series lags

(leads) the cycle by i quarters. If the absolute value of the cross-correlation is highest at i

= 0, then the variable will be defined to move contemporaneously with the cycle.

Additionally, for the whole sample period the critical value for the correlation

coefficients[4] is 0.11. Therefore it can be seen that both consumption and investment

move contemporaneously with the cycle and are highly procyclical. Importantly for the

results to be presented below, the inflation rate is procyclical and lags the cycle, whereas

the nominal interest rate is countercyclical and leads the cycle. These results are not new

and well known in the RBC literature, but what has not been determined is how well a

NK model can fit these facts.

3. A Standard New Keynesian Model.

Most current models used for monetary analysis[5] are derived from optimising behaviour

that can be simplified into three equations. An expectation IS that relates consumption (or

output) to its expected future value and depends negatively on the real rate of interest; a

Phillips curve that arises from the presence of nominal rigidities, typically in goods prices

á la Calvo and a monetary policy rule that describes the setting of the monetary

instrument (the interest rate) either exogenously or as a result of maximising some

welfare criterion. The model to be presented in this section embodies all these features,

but also allows for endogenous capital, so that there is a role for investment. However, it

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[4] See McCandless and Weber (1995) or Hoel (1954). The standard deviation of the correlation coefficient

can be computed as: $(n-3)^{-\frac{1}{2}}$, where n is the sample size.

[5] Representative among these are Walsh (2003, Ch. 5), Galí (2003) and McCallum and Nelson (1997).

is well known (Ellison and Scott, 2000) that sticky price models with endogenous capital result in extremely high volatility in the model's variables at high frequency. This result normally arises due to the magnitude of the changes in the real interest rates. Because prices are temporarily fixed, a nominal shock has a direct, and large, effect on the real interest rate. This problem does not arise in flexible price models, such as RBCs, because the real interest rate is only affected by real factors, which results in smaller deviations from its steady state, so that consequently, investment behaves in a manner consistent with the data. As a result of this high volatility in investment it is necessary to posit some restriction, and the model in this section will assume adjustment costs to investment. This model is almost identical to that in Casares and McCallum (2000) and the reader is asked to refer to it for details, where all variables denote deviations from steady state:

$$c_t = E_t c_{t+1} - \sigma^{-1}\left(R_t - E_t \pi_{t+1}\right) \tag{1}$$

$$x_t = E_t x_{t+1} + \gamma\left(\frac{\theta - 1}{\theta} E_t f_{k,t+1} - \left(R_t - E_t \pi_{t+1}\right)\right) \tag{2}$$

$$f_{k,t} = \bar{f}_k (y_t - k_t) \tag{3}$$

$$k_{t+1} = (1 - \delta)k_t + \delta x_t \tag{4}$$

$$y_t = \frac{C}{Y} c_t + \frac{G}{Y} g_t + \frac{X}{Y} x_t \tag{5}$$

$$\pi_t = \phi_0 E_t \pi_{t+1} + (1-\phi_0)\pi_{t-1} + \phi_1 \tilde{y}_t + \xi_t \tag{6}$$

$$R_t = (1-\mu_3)[\mu_1 \pi_t + \mu_2 \tilde{y}_t] + \mu_3 R_{t-1} + v_t \tag{7}$$

$$\hat{y}_t = z_t + \alpha k_t \tag{8}$$

$$\tilde{y}_t = y_t - \hat{y}_t \tag{9}$$

Equation (1) represents the expectational IS, with σ denoting the coefficient of relative

risk aversion[6]. Equation (2) is the investment equation that arises as a result of the

presence of investment adjustment costs, where γ is a function of the adjustment cost

function and θ is the elasticity of demand. Equations (3) and (4) simply represent the

marginal product of capital and the transition equation for capital, respectively. Equation

(5) is the aggregate resource constraint and equation (6) is a Phillips curve á la Fuhrer and

Moore (1995). For robustness analysis this paper will analyse the consequences of

varying the parameter ϕ_0, so that the standard New Keynesian Phillips Curve (NKPC)

that arises from Calvo pricing will be nested within this framework. Finally, (7)

represents a monetary policy rule[7] with $\tilde{y}_t$ and $\hat{y}_t$ being the output gap and the flex-price

level of output. It is important to note that the monetary authority reacts to the gap

between sticky-price output and its flexible-price counterpart, rather than cyclical output

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[6] Or alternatively in this model, the inverse of the intertemporal elasticity of substitution in consumption.
[7] This rule has been chosen following McCallum and Nelson (1999).

itself. The fact that central banks are aware of this distinction is evident in their publications and speeches where high productivity growth is not regarded as inflationary[8]

One should also note that there are four shocks in this model. Fiscal policy shocks, g_t, enter the IS equation and the more persistent they are, with ρ_g denoting its autocorrelation coefficient, the lower its impact on consumption. Technology shocks, z_t, affect potential output and therefore have a direct effect on the NKPC and the monetary policy rule. Additionally, there are monetary policy shocks, v_t, and cost-push shocks (ξ_t). The latter are important in that the provide a theoretical rationale for the existence of a short-term tradeoff between inflation and output stabilisation, even if it is not clear how this shocks originates in the model.

3.1 Calibration.

The calibrated values are shown in Table II and these are standard in the NK literature, where ρ_z is the autocorrelation of the technology shock (similarly for fiscal policy). δ is the depreciation rate, set at 10% per annum, θ (the elasticity of demand) has been set at 6 and the volatility of the cost-push shock is the same as in McCallum (2001). The paper will also present results for different values of ϕ_0 and ϕ_1, given the considerable disagreement over the specific formulation of the Phillips curve. Finally, $\dfrac{C}{Y}$ equals its long run average of 0.8.

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[8] For a discussion on this issue from a central bank perspective see ECB (2000).

Table II: Calibration

Parameter	Value
ϕ_0	0.5
ϕ_1	0.05
β	0.995
δ	0.0025
γ	2.5
θ	6
ρ_z	0.95
σ_z	0.007
σ_ξ	0.002
σ_g	0.003
σ_v	0.0017
$\dfrac{C}{Y}$	0.8
μ_1	1.5
μ_2	0.1
μ_3	0.8

4. Assessing the New Keynesian Model.

4.1 Model Variants.

This section will assess the NK model using 3 different variants[9]. Each model will be denoted by a different suffix. All the simulated data from the models is contained in the tables in the Appendix. The figures present the dynamic cross-correlations in graphic form. The first model is the one with the calibrated values described in Table II; model 2 only differs from the previous one in that the value of ϕ_1 is equal to 0.1. Model 3 contains the New Keynesian Phillips Curve, that is, inflation is purely forward-looking and the coefficient on the expected future inflation is equal to β, the discount factor. To contrast with model 3, the fourth model has a value of $\phi_0 = .1$ so that inflation is predominantly backward looking. The results for these models are all contained in the appendix, but the cross-correlations can also be seen in graphically, as the figures below show.

Y denotes the autocorrelation coefficients for the data (GDP). As can be seen clearly, changing the values in the Phillips Curve has no perceptible effect on the results and both models only replicate de data qualitatively.

With respect to consumption and investment (not reported here), again the models are able to broadly capture the main dynamic relationships in the data, as shown in Figure II, with both models virtually indistinguishable when real variables are considered..

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[9] Changes in ϕ_1 do not really alter the results and are therefore not reported here. These are available from the author upon request.

Figure I

Output Autocorrelations.
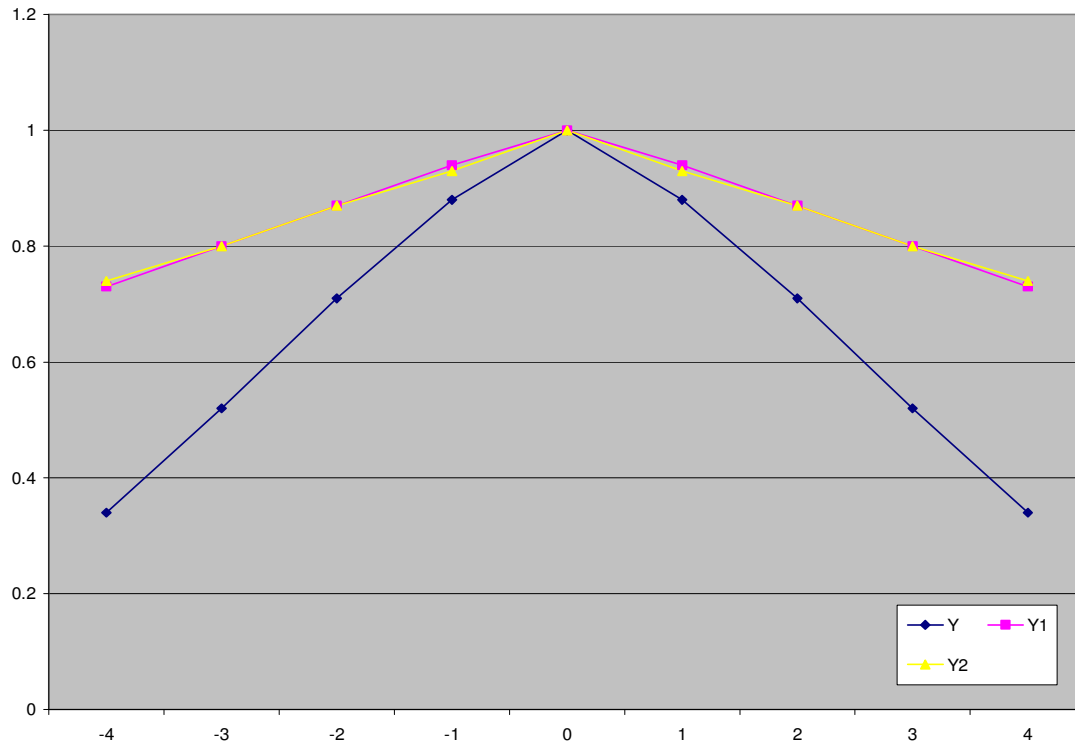
Nevertheless, this success is not surprising when one considers that RBCs possess similar features and these NK models have the same underlying real structure. In this regard, the main contribution of NK models is their ability to provide an account of the real effect of nominal variables. Figure III present the results for the cross correlation of output with inflation.

Figure II

Output and Consumption
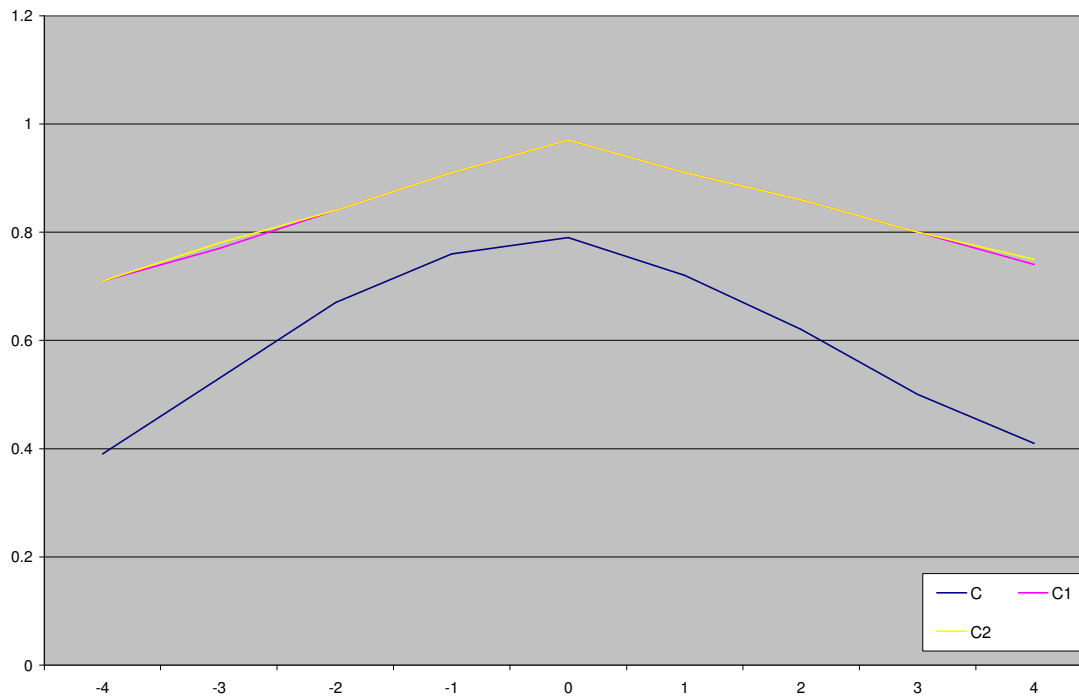
It becomes apparent that none of the models described here are able to capture the main dynamics of the data, even qualitatively. The data exhibits a phase shift with the inflation rate lagging the cycle peaking at around four quarters. Instead, the NK models all imply contemporaneously countercyclical inflation. Moreover, this result is quite robust to parameter change, posing a serious challenge to sticky price models of the business cycle. If one extends a similar analysis to the behaviour of the nominal interest , the problems is as severe as in the previous case. Again, the data exhibit a phase shift, with interest rates initially being strongly countercyclical and then procyclical.

Figure III

Output and Inflation
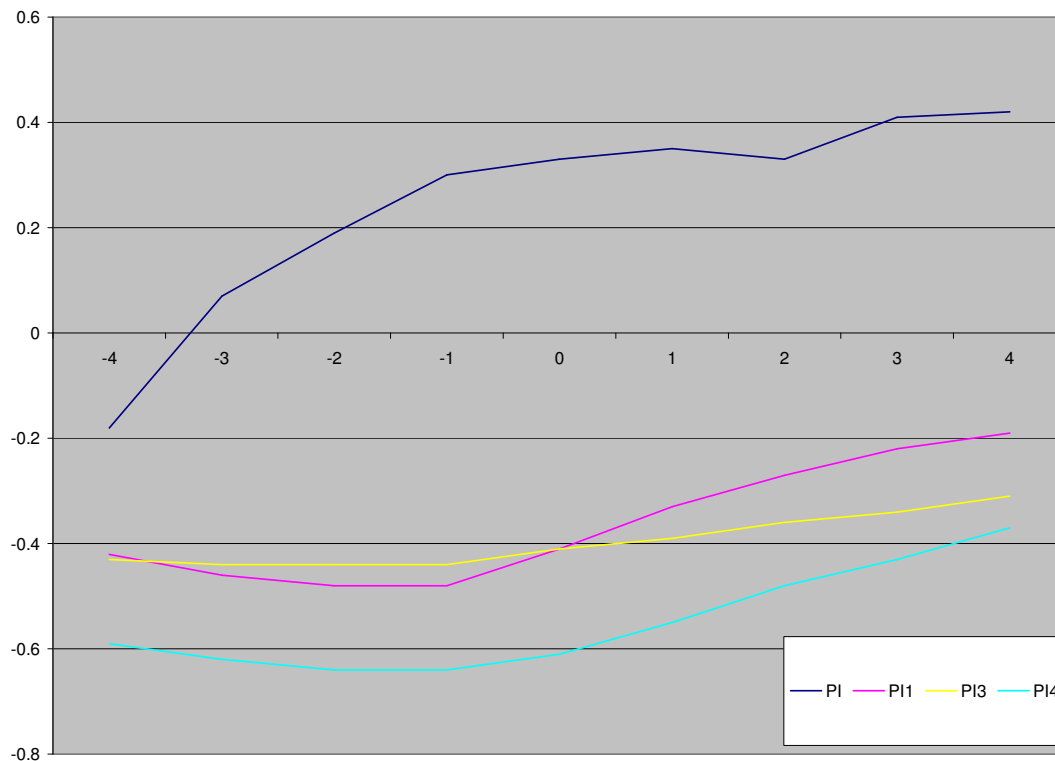
Thus for these two nominal variables, interest rates and inflation, NK models provide very little explanation. This is surrpising, given the progress that has been made in the field and improvements in estimating monetary policy rules and robust estimates of the NKPC. So this begs the question: how should these models be modified?

4.2 The Role of Technology.

Ever since the Kydland and Prescott (1982) argued that technology shocks were central to understanding fluctuations, many economists (Summers, 1986) have argued that the

role of technology has been overstated. More recently, Galí (1999) has argued that technology shocks are much smaller than generally estimated. Could this provide an explanation for the puzzles above? Taking the approach to an extreme, one could explore the effects of eliminating technology shocks altogether.

Figure IV

Autocorrelation for Output
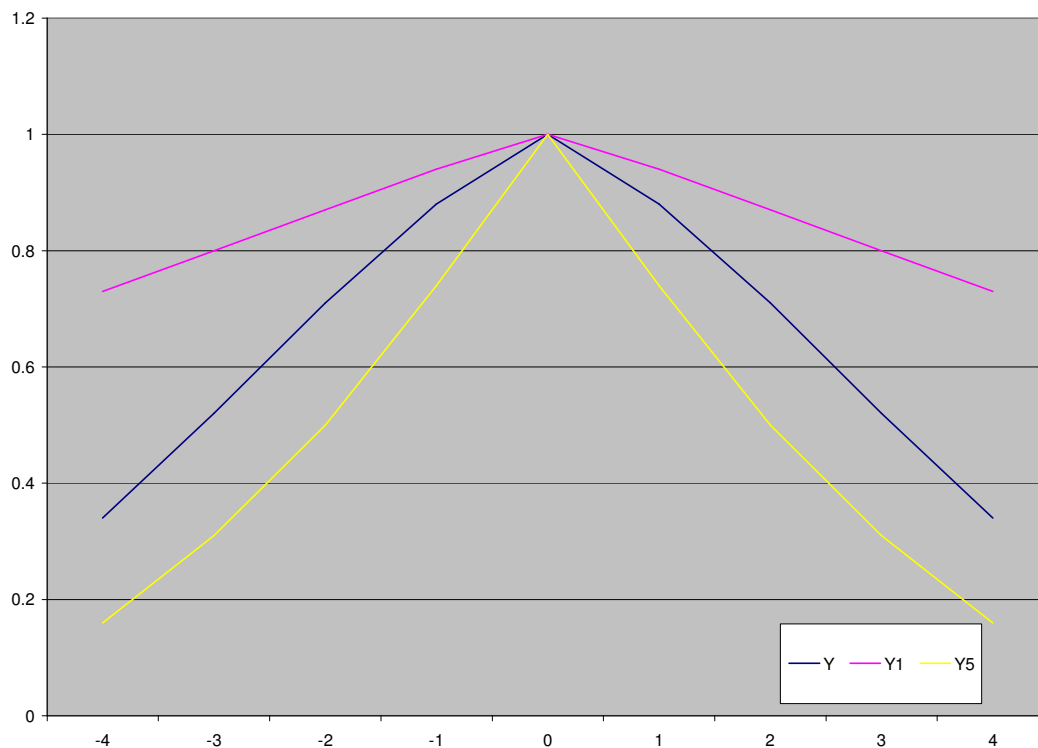
The fifth model in this paper therefore is identical to the benchmark model except that technology shocks are absent. Figures IV and V show the results for output and inflation, with the first model included for comparison purposes.

Figure V

Correlation with Inflation
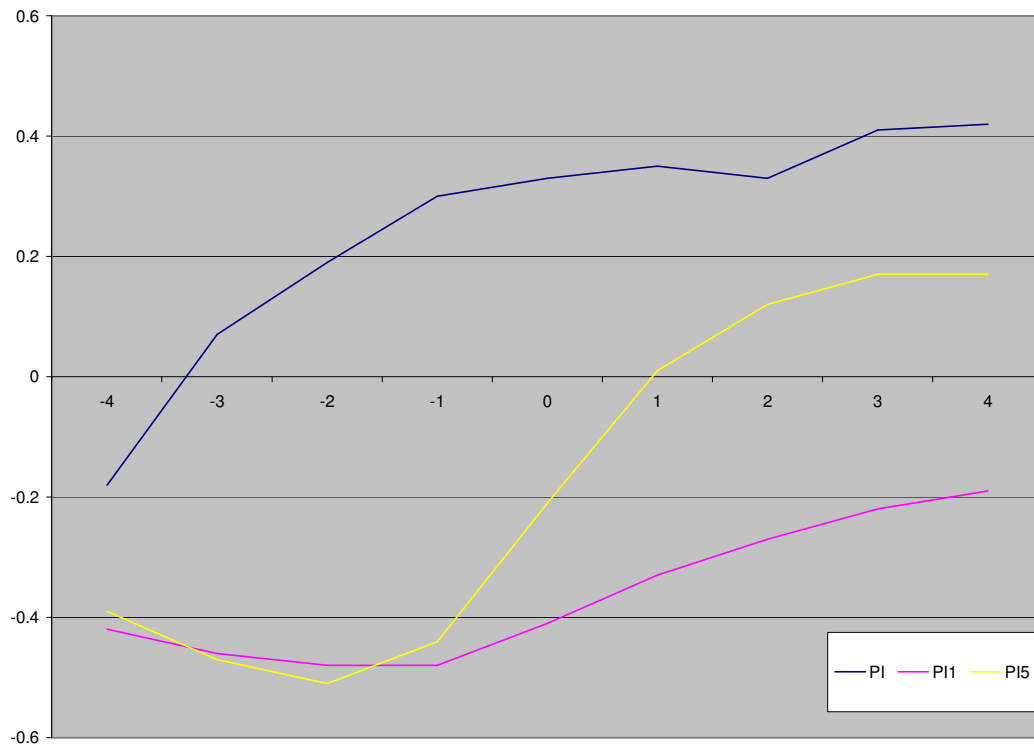
In the case of Figure IV, the data lies in-between both models, so that one could explore whether positive, but small volatility in the technology shocks may explain the dynamic behaviour of output. With respect to inflation, the fifth model now indicates that inflation is countercyclical and leads the cycle, whereas in the data it is procyclical, lagging the cycle. Finally, for the behaviour of interest rates (see Figure VI below), the behaviour of the model has worsened.

Figure VI

Output and Interest Rates
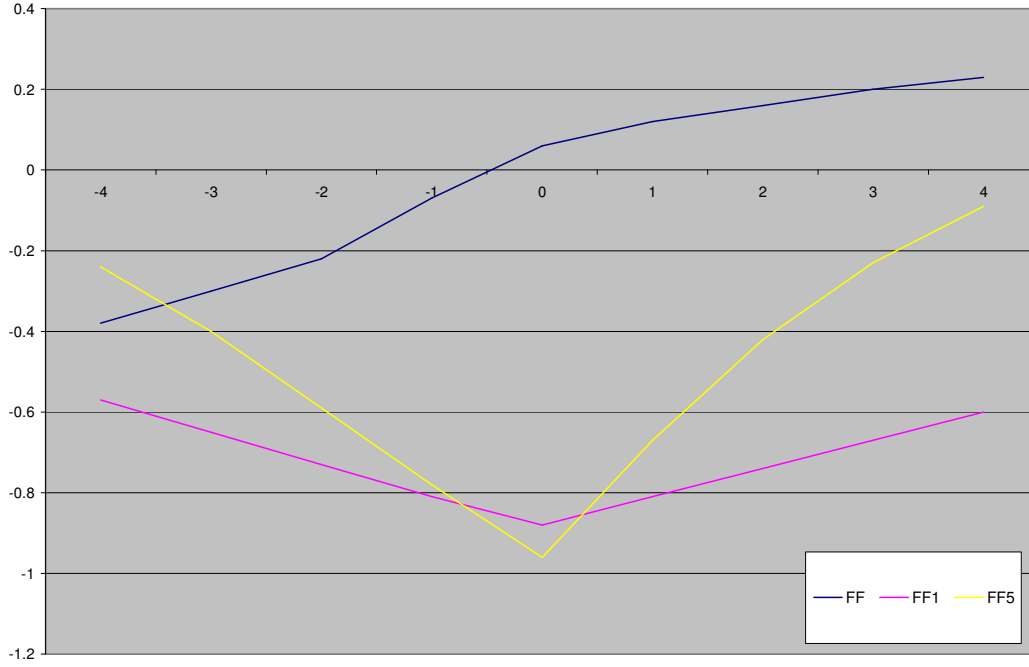
4.3 Focusing on the Output Gap.

One possible criticism to the results above is that the data have been detrended and this has affected the results. Consequently, if the benchmark model presented above is re-written in terms of the output gap, so that the model resembles those presented in Galí (2003) and Clarida, Galí and Gertler (1999), the IS equation can now be expressed as:

$$x_t = E_t x_{t+1} - \sigma^{-1}\left(R_t - E_t \pi_{t+1}\right) + (1-\rho_g)g_t - (1-\rho_z)z_t \qquad (10)$$

In this model the output gap measured being directly dependent on the percentage change in real marginal cost[10], although this approach is also subject to criticism (Rudd and Whelan. Figure VII present the dynamic cross-correlations for this model. Again, the results are robust.

Figure VII

Output Gap and Inflation
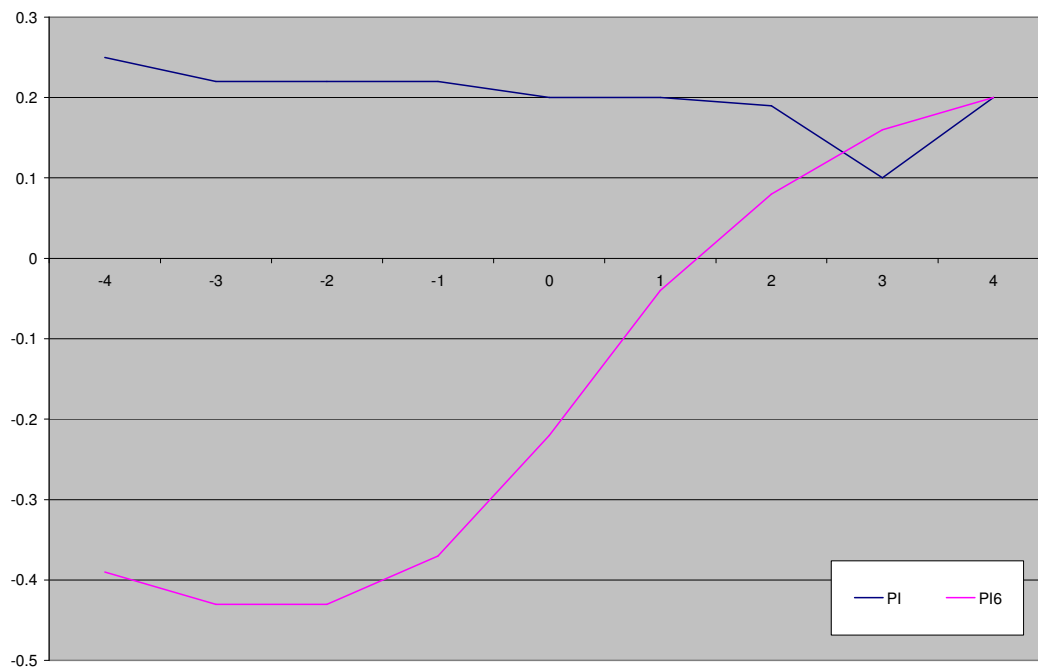
5. Conclusion.

This paper has attempted to assess New Keynesian models using RBC methods and it clearly emerges than even though these models were devised to provide for a better

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[10] I would like to thank Jeremy Rudd for kindly providing the labour share data.

understanding between real and nominal variables, the results are primarily negative. Nevertheless, these results should not be interpreted as implying that NK models are poor at capturing the key elements of the monetary transmission mechanism, since these models perform well in other dimensions. Rather, further research is needed in acquiring a proper understanding of the dynamics, the propagation mechanism, and on the influence of the shocks in these models. One could indeed argue that a minimum criterion for a good model is that should be able to mimic the data and here the NK model still requires modifications.

References

Casares, M. and B.T. McCallum. 2000. "An Optimising IS-LM Framework with Endogenous Investment". NBER Working Paper No. 7908. September.

Clarida, R. J. Galí and M. Gertler. 1999. "The Science of Monetary Policy: A New Keynesian Perspective". Journal of Economic Literature, Vol. XXXVII, December, 1661-1707.

European Central Bank. 2000. "Monthly Bulletin". October. Frankfurt.

Goodfriend, M. and R. G. King. 1997. "The New Neoclassical Synthesis and the Role of Monetary Policy."

Hoel, P. G. 1954. "Introduction to Mathematical Statistics." New York: Wiley.

King, R. G. and C. I. Plosser, 1994. "Real Business Cycles and theTest of the Adelmans," Journal of Monetary Economics 33, 405-438.

King, R. G. and Rebelo, S., 2000. "Resuscitating Real Business Cycles". NBER Working Paper No. 7534, (February).

McCandless, G. T. and W. Weber, 1995. "Some Monetary Facts," Federal Reserve Bank of Minneapolis Quarterly Review, Vol. 19, 3, 2-11.

Kydland, F. E. and E. C. Prescott, 1982. "Time to Build and Aggregate Fluctuations." Econometrica, Vol. 50 (6), 1345-1370

McCallum, B. T., and E. Nelson, 1999a. "An Optimising IS-LM Specification for Monetary Policy and Business Cycle Analysis," NBER Working Paper 5875.

Rudd, J. and K. Whelan. 2002. "Does Labour's Share Drive Inflation?" mimeo.

Summers, L. H., 1986. "Some Skeptical Observations on Real Business Cycle Theory." Federal Reserve Bank of Minneapolis Quarterly Review, 10 (4) Fall, 23-27.

Walsh, C. 2003. "Monetary Theory and Policy." Second Edition. Cambridge, MA: MIT

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TABLE A1

Benchmark model: first row: US data; second row: model data, model 1.

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
Y	2.04	1	.94	.73	.80	.87	.94	1	.94	.87	.80	.73
C	0.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
C	0.81	0.40	.94	.71	.77	.84	.91	.97	.91	.86	.80	.74
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
X	7.64	3.75	.93	.73	.79	.86	.93	.99	.93	.85	.78	.72
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
PI	0.58	0.28	.71	-.42	-.46	-.48	-.48	-.41	-.33	-.27	-.22	-.19
FF	1.64	1.15	.77	-.43	-.28	-.11	.19	.42	.48	.47	.43	.40
FF	0.39	0.19	.88	-.57	-.65	-.73	-.81	-.88	-.81	-.74	-.67	-.60

TABLE AII

Benchmark with $\phi_1 = 0.1$ Model 2.

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
Y	2.02	1	.93	.74	.80	.87	.93	1	.93	.87	.80	.74
C	0.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
C	0.81	.40	.94	.71	.77	.84	.91	.97	.91	.86	.80	.75
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
X	7.56	3.74	.93	.73	.79	.86	.93	.99	.92	.85	.78	.72
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
PI	0.56	0.28	.70	-.40	-.44	-.46	-.44	-.37	-.29	-.24	-.20	-.17
FF	3.44	2.42	.94	-.38	-.30	-.22	-.07	.06	.12	.16	.20	..23
FF	0.36	0.18	.87	-.61	-.68	-.76	-.84	-.91	-.84	-.77	-.70	-.63

TABLE AIII
Model with NKPC. Model 3

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
Y	1.82	1	.92	.73	.79	.86	.92	1	.92	.86	.79	.73
C	.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
C	0.73	0.40	.94	.70	.76	.83	.90	.97	.90	.85	.79	.74
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
X	6.84	3.76	.92	.73	.79	.85	.92	.99	.91	.84	.78	.72
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
PI	0.28	0.15	.40	-.43	-.44	-.44	-.44	-.41	-.39	-.36	-.34	-.31
FF	3.44	2.42	.94	-.38	-.30	-.22	-.07	.06	.12	.16	.20	..23
FF	0.3	0.16	.84	-.56	-.62	-.69	-.78	-.88	-.81	-.75	-.69	-.63

TABLE AIV
Backward looking model. Model 4

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
Y	2.17	1	.94	.76	.82	.88	.94	1	.94	.88	.82	.76
C	.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
C	0.86	0.40	.95	.73	.79	.86	.91	.97	.92	.87	.82	.76
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
X	8.15	3.76	.94	.76	.82	.88	.94	.99	.94	.87	.81	.75
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
PI	0.50	0.23	.89	-.59	-.62	-.64	-.64	-.61	-.55	-.48	-.43	-.37
FF	3.44	2.42	.94	-.38	-.30	-.22	-.07	.06	.12	.16	.20	..23
FF	0.49	0.23	.92	-.57	-.64	-.71	-.78	-.85	-.81	-.77	-.71	-.66

TABLE AV
Benchmark without technology shocks

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
Y	0.67	1	.74	.16	.31	.50	.74	1	.74	.50	.31	.16
C	.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
C	0.23	0.34	.77	.14	.28	.47	.69	.93	.69	.47	.30	.16
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
X	2.7	4.03	.76	.16	.30	.48	.71	.96	.71	.47	.28	.14
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
PI	0.53	0.79	.67	-.39	-.47	-.51	-.44	-.21	.01	.12	.17	.17
FF	3.44	2.42	.94	-.38	-.30	-.22	-.07	.06	.12	.16	.20	..23
FF	0.27	0.40	.77	-.24	-.40	-.59	-.78	-.96	-.67	-.42	-.23	-.09

TABLE VI
Model Written in Terms of the Output Gap.

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
X	1.04	1	.94	.76	.82	.88	.94	1	.94	.88	.82	.76
X	0.76	1	.82	.33	.47	.64	.82	1	.82	.64	.47	.33
PI	0.96	0.92	.48	.25	.22	.22	.22	.20	.20	.19	.10	.20
PI	0.7	.92	.79	-.39	-.43	-.43	-.37	-.22	-.04	.08	.16	.20
FF	1.68	1.61	.76	.31	.31	.71	.29	.18	.14	.13	.11	.12
FF	0.63	.83	.94	-.26	-.32	-.38	-.42	-.43	-.30	-.17	-.06	.03

TABLE VII
Model with Current Values in Monetary Policy Rule

Variable	σ_x	σ_x/σ_y	ρ_1	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4
Y	1.42	1	.88	.34	.52	.71	.88	1	.88	.71	.52	.34
Y	2.07	1	.93	.70	.78	.85	.93	1	.93	..85	.78	.70
C	.89	0.63	.89	.39	.53	.67	.76	.79	.72	.62	.50	.41
C	0.82	0.44	.94	.68	.75	.83	.90	.97	.91	.85	.78	.72
X	4.05	2.85	.88	.40	.53	.69	.84	.91	.82	.68	.50	.32
X	7.79	3.76	.93	.70	.77	.85	.92	.99	.92	.84	.76	.69
PI	0.96	0.68	.48	-.18	.07	.19	.30	.33	.35	.33	.41	.42
PI	0.48	0.23	.65	-.41	-.47	-.52	-.54	-.51	-.37	-.27	-.20	-.57
FF	3.44	2.42	.94	-.38	-.30	-.22	-.07	.06	.12	.16	.20	..23
FF	0.4	0.19	.86	-.48	-.56	-.66	-.76	-.86	-.81	-.73	-.65	-.57