Rational Expectations: An Econometric Investigation

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Paul Scanlon employs an econometric approach to empirically test the usefulness of rational expectations in consumption theory. This idea is central to the new classical school's approach and it is concluded that the theory has got a significance for real world policy decisions.

"*...Mr Lucas... exorcised the dim-witted actor from macroeconomics*".

The Economist, 30th March 1996.

Introduction

In 1995 Robert Lucas won the Nobel Prize in Economics for his seminal work on the rational expectations hypothesis. Described by *The Economist* as "the most influential macroeconomist of his generation", Lucas's theories have doubtless undermined traditional Keynesian economics and paved the way for 'new classical economics'. Although Keynes was conscious of the significance of the elusive and intangible 'expectations' concept (what he called 'animal spirits'), he never explicitly incorporated expectations into his models. Although the concept was again propounded by Muth in the seventies, it was Lucas who, through rigorous mathematics, finally incorporated the rational expectations hypothesis into a quantitative and tractable form. Today the hypothesis has assuredly become the *sine quo non* of macroeconomics.

In this paper I attempt to model changes in real household consumption. I believe that consumption, which comprises most of GNP, lies at the heart of any economic system. If consumer consumption begins to falter, then this will have perilous consequences for the entire economy, and perhaps others too. Such marks the onslaught of the conventional 'slowdown' or recession. A sharp decline may well cause the entire economy to founder. Soon the economy is in the doldrums. However, I further contend that at the heart of the consumption debate, lies the aforementioned concept of 'rational expectations' and consumer sentiment. It is arguable, for instance, that the persistent moribund state of Japan's economy and the government's continued failure to stimulate it is entirely attributable to consumer pessimism and expectations of further decline. Conversely, and on more local scale, Ireland's continued consumer confidence is surely partly attributable to expectations of further prosperity. Success breeds success. It should be clear that the concept of the self-fulfilling prophecy is, in many ways, pivotal to all of this.

In this paper I attempt to both qualify and quantify some of the above assertions. I model the increase in real household consumption on three regressors, the increase in employment, the government financial balances and short-run interest rates. Although the model does not explicitly embrace income, we shall see that it *implicitly* does. The data is cross-sectional and is from seventeen OECD countries in 1997. Throughout my analysis the role of 'rational expectations' is emphasised. Although the model lacks the mathematical sophistication of many existing such models, I maintain it indeed has considerable explanatory power and possesses an intuitive simplicity.

It is also my intention to give a brief analysis of the application of some of these concepts to the case of Ireland over the past fifteen years or so. It has been postulated that much of the above has been highly instrumental to the Irish recovery

in the late eighties. Thus, I maintain my analysis has broad applicability, and is highly applicable to Ireland on a local level. Ultimately, then, I hope to explain what I believe, was one of the underlying reasons for our recovery, and hence phenomenal growth today.

The Econometric Model

My multiple regression model is as follows:

%D CONSUM = b_0 + b_1 (%D EMPLOY) + b_2 (GOVBAL) + b_3 (SRINTRATE) + e

where: e refers to the *stochastic disturbance term*.

CONSUM refers to *real private consumption expenditure*.

EMPLOY refers to *employment.*

GOVBAL refers to *general government financial balances.*

SRINTRATE refers to *short-term interest rates.*

In my analysis I used the latest available data from the OECD *998*. Thus, I deal with 1997 data throughout. To estimate the foregoing model I invoke the method of ordinary least squares (OLS) and apply it to seventeen OECD countries. Most of the countries I omit, I believe are not representative of the conventional case. I have excluded Hungary and the Czech Republic, for instance, due to the current state of transition they are in, and I feel such "anomalies" would not be amenable to my analysis.

The analysis yields the estimated multiple regression equation:

% D CONSUM = .344 + .805 (% D EMPLOY) + .517 (GOVBAL) + .431 (SRINTRATE)

prob =	(.629)	(.000)	(.006)	(.006)
t =	.49	5.38	3.30	3.28

$F_{(3, 13)}$ = .000, R^2 = .898, R^2 (adj.) = .875

Further regressions on the individual variables yielded the following:

%D CONSUM = .971 + 1.2 (%D EMPLOY)

prob =	(.051)	(.000)

$F_{(1, 15)}$ =.000, R^2 = .66, R^2(adj.) = .64

%D CONSUM = 4.107 + 1.086 (GOVBAL)

prob =	(.000)	(.001)

$F_{(1, 15)}$ = .001, R^2 =.52 , R^2 (adj.) =.48

%D CONSUM = - .973 + .867 (SRINTRATE)

prob =   (.429)   (.005)

$$F(1, 15) = .005, R^2 = .42 , R^2 (adj.) = .39$$

Some General Remarks

Although I will discuss each of the coefficients in turn, let me first give a cursory general analysis of overall results. Each of the coefficients is significant at the 1% level and thus is highly significant. The F-statistic is similarly highly significant, indicating that the model indeed has explanatory power and that the hypothesis that all the coefficients are zero can be readily rejected. The coefficient of (multiple) determination is high at approx. 90%, but the adjusted coefficient of (multiple) determination gives a more realistic figure of 88%. By any standards these figures are particularly high and indicate that approx. Movements in the regressors can explain 88% of the increase in real private consumption figure. Also, the Akaike Information Criterion decreased with the addition of each variable, indicating they all contribute explanatory power. The Durbin-Watson statistic is not applicable since we are dealing with cross-sectional, as opposed to time-series data. I also note the absence of any serious multicollinearity in the model. All of the regressors are highly significant and the standard errors are relatively small. Furthermore, all of the regression coefficients have the predicted signs (to be discussed).

An analysis of the error terms is fundamental to any regression analysis, since any violation will invalidate our significance tests. It was clear from the histogram of residuals that they approximate the normal distribution. It was evident from the error band that the error variances are approximately equal, indicating homoscedasticity. Also, the standard errors are approximately zero and all lie within 1.5 standard errors of their mean. Hence, I may conclude that $e_i \sim$ iid N (0, s 2) . All augurs well for the application of the Gauss-Markov Theorem; we may infer our tests of significance are applicable and that our estimators are BLUE (Best Linear Unbiased Estimator). The standard error of regression, indicating the standard deviation of the residuals, and another measure of goodness of fit, is relatively small, signifying good fit. The error analysis also bodes well for model specification.

I tentatively note, however, the possibility of a simultaneity bias in the model. It is clear that an increase in employment should cause an increase in consumption. However, that causation could conceivably go the other way. Herein lies the potential for simultaneity. This would cause our regressors to be correlated with the error term violating one of our classical linear regression assumptions (orthogonality) and thereby leading to bias and inconsistency under OLS estimation. In this analysis I deal exclusively with the one-way causation depicted above and content myself that the bias fails to adversely affect model results (or if it does so, the bias is not so serious as to invalidate my model). Given that the sample size is relatively small I contend this is a reasonable assumption.

The correlation matrix illustrates correlations of 81%, 72% and 65% between each of EMPLOY, GOVBAL, SRINTRATE and CONSUM respectively. These are indicative of high linear correlations among the variables in question. Given that none of the regressors are more highly correlated with each other than with that with CONSUM, we can conclude again that multicollinearity would not appear to be a problem. I contend that the specification of the model is accurate. I argue this more thoroughly later, but I believe all relevant variables are encompassed in the model and furthermore that no variable that is included is superfluous.
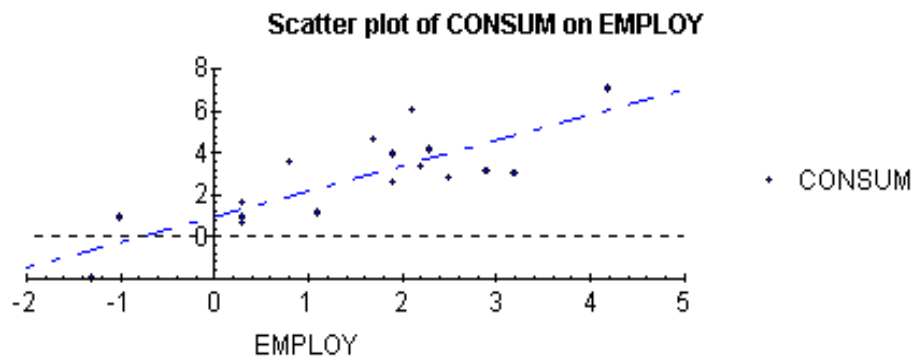
Omitting observations from my analysis continues to yield healthy results. Indeed, omitting the first two countries (USA, UK) yields results that are remarkable. The model in this case yields a coefficient of determination of 93%. Furthermore, an analysis from countries 10 - 17 yields an adjusted coefficient of determination of 99%. Finally, the Chow Test for parameter stability was administered using two sample sets, countries 1 to 9 and countries 10 -17. The result is not significant and provides evidence in favour of the two sets of regression coefficients being equivalent (and hence parameter stability).

An Analysis of Individual Regressors.

EMPLOY *(or %increase in employment)*

The coefficient of EMPLOY is in this case an elasticity. This variable was found to be highly significant (in fact the most significant regressor) both in the model itself and on an individual regression with CONSUM where it yielded an R^2 of 0.66. The scatterplot illustrates an obvious positive linear relationship.
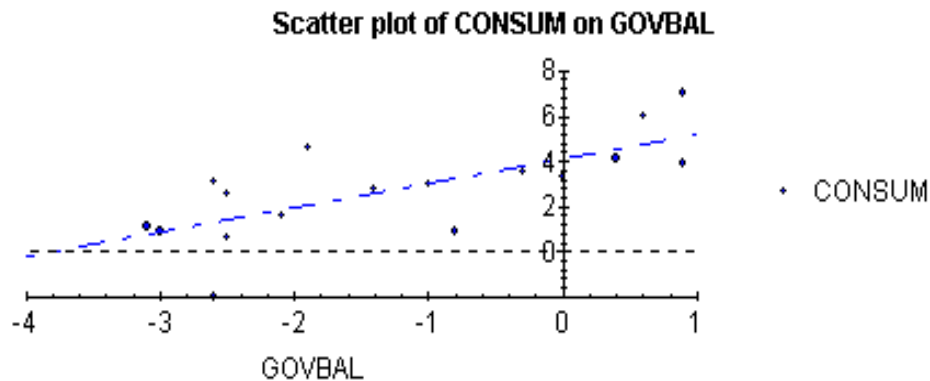
It is intuitively appealing that an increase in employment will through, a better endowed consumer, increase consumption. This is indeed verified in my analysis. Also, an increase in employment should, through the corresponding increased demand for labour, precipitate a growth in labour compensation. This is particularly true in the case of a tight labour market. Given dormant or creeping inflation, the real wage will rise. So we could reasonably conclude that an increase in this figure should ultimately be associated with an increase in real disposable incomes. For this reason I suggest this figure is an ample proxy for income movements and indeed gives a better indication of future consumption. This assertion was borne out by my analysis. The increase in employment and increase in real national income are highly correlated and the relationship is statistically significant. Furthermore, it was found that the EMPLOY regressor had greater explanatory power than that of the latter, when it was replaced my real national income. The inclusion of both variables introduces serious multicollinearity that would undermine results.

Scatter plot of CONSUM on EMPLOY

It is perhaps interesting that EMPLOY has greater explanatory power. I invoke the rational expectations hypothesis to elucidate my claim. As employment increases the rational consumer will discern a prosperous economy on a growth trajectory. He will foresee less of a tax burden in the future as the onerous social security burden is relaxed and the tax base widened. The result is a wealth effect and hence enhanced consumer sentiment, inducing the consumer to spend more today, as "permanent income" (in the Milton Friedman sense) increases, shifting the IS curve to the right. One could also perhaps suggest that with increased employment rates, the rational consumer would foresee inflation and hence prompting him to purchase at relatively cheaper levels today. Of course the converse of these arguments applies for a fall in employment.

GOVBAL *(or general government financial balances)*

Interestingly, a highly significant positive relationship was evident in my analysis between the increase in real household expenditure and the state of the government finances. The greater the deficit, the less the consumer expenditure and *vice versa.*

Scatter plot of CONSUM on GOVBAL

This is a powerful argument for the rational expectations hypothesis and the Ricardian Equivalence Theorem (or Ricardo-Barro effect). The poorer the state of the government balances, the greater the future tax burden. Hence the rational consumer will moderate his consumption behaviour and increase precautionary savings; he will save to smooth out permanent income and offset the greater future tax liability. Barro has argued that the actual financing of the government deficit (either through government bonds or taxes) is irrelevant. The perspicacious consumer with reasonable foresight will easily discern that a bond financed deficit will eventually result in the imposition of greater taxes. Hence poor governmental finances under rational expectations should always reduce present consumption. The proposition that consumers are risk averse corroborates much of this argument. Similarly, a healthy government balance is indicative of auspicious economic circumstances and invariably sends positive signals to consumers, inducing them to save less and spend more. Thus, healthy government finances may engender a kind of virtuous cycle, where consumers continually find it rational to increase expenditure. The argument can, of course, go the other way. This kind analysis underlies much of the discussion of Ireland's recent transition from stagnation to prosperity.

Some of the arguments propounded in this domain are most interesting. Some (e.g. Giavazzi & Pagano) argue that increased taxes today, when followed by reduced government spending, actually increase consumption in the case of risk averse consumers since it reduces future uncertainty and increases future income. Barro has argued that in the case of infinite time horizons and taxes to be imposed on the next generation, the altruistic consumer will still increase saving, so that he can compensate the next generation, through greater bequests, so as the tax burden, when it indeed falls due, will not be unduly burdensome (the intergenerational altruism model).

SRINTRATE *(or short-run interest rates)*

A highly significant *positive* relationship between the increase in consumption and short-term interest rates within the model itself and on an individual basis with CONSUM is the most surprising result of my analysis. At first the relationship strikes one as perplexing and at variance with conventional economic theory. However, a finer analysis reveals more subtle results. One possible argument entails an invocation of Irving Fisher's model of intertemporal choice for the case of a saver. Fisher depicted two time periods, a budget constraint (indicating the cost of consumption today relative to consumption tomorrow in terms of the interest rate) and proceeds with an indifference curve analysis. It is arguable that an increase in the rate of interest causes the income effect of the rate rise to outweigh the substitution effect in the present period (i.e. we get the somewhat counterintuitive result that present consumption will *increase* when the interest rate *rises).* However,

for this to occur we would have to have high saving rates and low borrowing rates among the countries in my analysis. Perhaps Japan's extremely low interest rates are having this detrimental effect on consumption in a country with such high savings rates. On this vein, note Japan's high leverage on the accompanying scatterplot.

The above explanation would appear to be consistent with my empirical evidence from the OECD. Higher interest rates would appear to be engendering 'wealth effects' among consumers, spurring a rise in consumption. However, other reasons also support my evidence. In the case of an overheating economy (high consumption) monetary authorities will strive to keep the economy in check with higher interest rates. This will dampen consumer demand and precipitate an exchange rate appreciation, thus curbing inflation. Thus, in this case, higher interest rates will again accompany high consumption (but not imply *causation*). One could argue, however, that high interest rates surely engender inflationary expectations, prompting consumers to spend now rather than later (and *thereby* implying causation). Conversely, low interest rates engender deflationary expectations prompting consumers to save and purchase at cheaper price levels in the future. Again note the case of Japan.

Also, one could argue that low interest rates are a cause for concern for the rational consumer. The circumspect consumer will soon become 'suspicious' if rates plunge too low for he will fear impending recession. This could be indeed what is happening in Japan, as consumers fear continued economic stagnation and are thus reluctant to spend. Similarly, it was evident last year that Alan Greenspan feared letting interest rates fall too much, in case he would rouse consumers` anxieties. Conversely, high interest rates (among the countries in my analysis, anyhow) are often a sign that the economy is overheating and, by implication, is doing well. Thus high rates may send a positive signal to consumers enticing them, perversely, to spend *more* (rather than *less*). Under rational expectations, fiscal and monetary policies can be wholly impotent.

Conclusion

In this paper I have endeavoured to ascertain the primary determinants of consumption in certain OECD countries. In all cases my analysis yielded statistically significant results. As should be clear, throughout the paper I have emphasised the "new classical economics" approach, the primary tenets being rational expectations, perfect capital markets and intertemporal choice. The relevance, power and usefulness of this approach to economic thinking should be apparent. It is salutary to bear in mind that, although we are dealing in the main with inherently psychological concepts, they be reasonably quantified with proxy variables such as the state of the government finances. I also discussed briefly the applicability of the approach to ascertaining the elusive roots of our present and continued economic prosperity. The evidence leads to an espousal of the "expansionary fiscal contraction" hypothesis postulated by McAleese in the early nineties.

Although the rational expectations hypothesis has been attacked on the grounds that consumers do not always exhibit perfect foresight, the hypothesis claims that consumers are not systematically wrong and persistently deluded. We should content ourselves with the latter. Policymakers should also bear this in mind. Reckless, profligate government policies may shatter a governments credibility and suppress consumer confidence as opposed to stimulate it. Governments should incorporate such expectations into policy and appreciate the concept of the "rational consumer"; in this sense consumers should no longer be beguiled by expansionary policies before an election.

It is my hope that I have imparted some insight into this exciting new area that has revolutionised macroeconomic thought over the past two decades or so. Like many theories in economics it has the virtue of being both compelling and tremendously effective. It was interesting to note *The Economist*'s reaction to Lucas` Nobel Prize:

"As this week's award of the Nobel Prize in economics shows, simple ideas are often the most powerful".

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